FLIGHT

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Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in this list:—

1932

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Apr. 29. Cinque Ports F.C. Dinner at Folkestone.
May 1. Northamptonshire Ae.C. Combined Motor-cycling and Flying Display.
May 1. Entries close at double fees for King's Cup Race.
May 5. "Training of Pilots and Instructors," Lecture by Group Capt. J. E. A. Baldwin, before R.Ae.S.
May 7. Antwerp Aviation Club Air Display and Garden Party.
May 14. Coventry Ae.C. Air Pageant.
May 14-15. Skegness Air Pageant.
May 16. Northamptonshire Ae.C. Annual Pageant.
May 16. Hertfordshire F.C. Air Display at Wheathampstead.
May 16. Shanklin Flying Display.
May 16. Southend F.C. Air Display.
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May 21. "Morning Post" Cross-Country Air Race, Heston.
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May 22-30. Conference of Transoceanic Aviators at Rome.
May 25. Opening of Royal Tournament, Olympia.
May 28. London-Newcastle Air Race for "Newcastle Evening World" Trophy.
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June 4. Leicester Ae.C. Flying Display and Motor Gymkhana at Ratcliffe Aerodrome.
June 5. Reading Ae.C. At Home, Woodley Aerodrome.
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June 11. Close of Royal Tournament, Olympia.
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June 21. Aero Golfing Society: "Flight" Challenge Cup, Bramshott G.C.
June 21-28. Blackpool Air Pageant, Stanley Park.
June 25. R.A.F. Display, Hendon.
July 8-9. King's Cup Air Race, start and finish Brooklands.
Nov. 25-Dec. 11. Paris Aero Show.

EDITORIAL COMMENT

ANOTHER summer approaches (may it be a sunnier one than the last!) and the air-minded British public begins to wonder what aeronautical events it will be able to enjoy before the curfew rings the knell of parting summer-time next October. There will, of course, be the Royal Air Force Display at Hendon and the race for the King's Cup. These are standing dishes. There will be various local flying displays by local aeroplane clubs, and Sir Alan Cobham's touring party will doubtless give delight to many thousands who have never seen anything of the sort before. Otherwise the programme of aeronautical events seems rather barren. In fact, the great feature of this summer as compared with last will be the absence of a Schneider contest.

Shall we Stand Still?

This holiday after an intensive effort will, perhaps, be hailed with relief by many. The feelings of the good people of Southampton, Portsmouth, Cowes, Ryde, and other towns in the neighbourhood are probably mixed. Some of them loathed the noise of racing engines roaring over their chimney-pots. Others loved to watch the speed of the machines at practice. Some enjoyed the importance of living at the hub of things; and others speculated on the chances of money being brought into their town. The directors and employees of the firms which produced the aircraft, engines, and the innumerable accessories, will also probably admit to mixed feelings. Preparing for a Schneider brought *kudos* and pelf to the firm; but rest after toil is sweet, and a Schneider meant sometimes a perfect agony of labour and anxiety. Governments certainly, even those who can boast subjects possessed of the wealth and generosity of Lady Houston, will surely rejoice that there will be no more Schneiders. On the whole, there was evidence that the world was getting a little tired of Schneider contests with their limitations, and is probably not grieved that the series is over.

At the same time, we ought not to forget the lessons which have been learnt while preparing for

Schneider races. As Wing Com. Orlebar pointed out in his paper read to the Royal United Services Institution, the team work between the designers of aircraft and engines and many accessories, all directed to the same end, could only have been inspired by the Schneider. Now that the Schneider series is over and done with, the question arises, are we to have no more development work in high-speed flying? There has been talk of another trophy being offered for international competition in high-speed seaplanes, but so far nothing has materialised. Possibly it is felt that at a time when every nation is in financial straits, it is wiser not to encourage expenditure even on such a worthy object as research. This heaviness, however, cannot endure for all nights, and a morning must come some time when we shall awaken to the joy of being able to indulge in a little profitable expenditure. Then, perhaps, someone will put up a cup for a seaplane race with different conditions, which will make the race more useful to the cause of progress than was even the Schneider series. In its latter years it was obvious that the Schneider had moved far away from the original intentions of M. Jacques Schneider, and consequently the conditions which he had framed were not those best calculated to help the contest towards fulfilling its new functions. The new contests could start with a clean slate, and the framers of the conditions would have a tolerably clear idea of the object at which they were aiming. They would put aside all thoughts of a seaworthy craft, and would aim solely at a speed race, using seaplanes because the water makes the most convenient aerodrome for aircraft which must have a high landing speed.

Until this happens, is the Air Ministry going to stand still in the matter of developing high-speed flying? The late victorious High Speed Flight has been dispersed, and no other body has taken its place. At the moment no progress is taking place. The experience acquired by designers and pilots at so much cost is rusting—for high-speed flying is like an edged tool ; it must be kept in use or else it will rust. It would be even more true to say that it cannot stand still. It must advance, or else it will recede. Is there any reason, we should like to know, why another High Speed Flight should not be formed to carry out experiment and development work with the existing machines? When more money became available, other machines could be ordered to embody the results of the research and experiment. The mere existence of such a flight would act as an incentive to the research workers and design staffs, and would keep alive the spirit of progress.

Another point arises. Would it not be policy for the new High Speed Flight to deal with landplanes as well as with seaplanes? Designers of fighter aircraft could then look ahead and try to visualise what the fighter of five years hence would be like. Certain risks could be taken which would not otherwise be justifiable, if it were known that the machine would go into the hands of a special flight trained to deal in high speed. It seems possible that in that way some very valuable work might be done, and the present advantage which British fighters enjoy over the corresponding machines of foreign nations might be, not only maintained, but even greatly accelerated.

A Great French Flight

We desire to offer our heartiest congratulations to the two French airmen, MM. Salel and Goulette, on their very fine performance in flying from Le Bourget to Capetown in 3 days 19 hours. Africa certainly seems to be shrinking, and we rejoice at that fact. There are, of course, parts of Africa where airmen must run risks, and Great Britain lost two fine pilots when the first Fairey long-range monoplane crashed into a mountain near Tunis. On the whole, however, there is no undue risk in attempting to cross Africa by some route other than the well-worn airway which is now followed by Imperial Airways. An African flight is in no way comparable to a flight across the Atlantic in a single-engined landplane. Africa, in fact, is a legitimate ground for those who like record-making to practise their art, or sport, or whatever one likes to call it. The record-breaking flights may not, perhaps, teach any very useful lessons, but there is no need to condemn them on that ground. They are a comparatively harmless amusement, and they certainly reflect great credit on the human endurance of the men who make them, as well as upon the reliability of the engines and the aircraft.

At the same time, the pace at which a number of private aeroplanes have lately scurried across to Capetown does make us long for the day when Imperial Airways will have the eight "Atalanta" class machines in service, and will be able, we hope, not only to increase the speed of their scheduled journeys, but also to achieve greater punctuality than they have yet found possible. It was stated in Parliament the other day that there have been 12 despatches of air mails from Croydon to Capetown, and the aeroplane reached the southern terminus on the due date on five occasions; while of the 11 arrivals from South Africa, three have been punctual. We believe that this is due mostly to the company having to use a type of machine on the sections south of Kisumu which was designed for flying across the Arabian desert (and which gave very good service there) and which in any case is not a modern design. Perhaps some of the trouble has also been due to lack of sufficient meteorological preparations in Rhodesia. However that may be, we shall feel more proud of our airway when it uses machines which can deliver the goods—and mails.

Records, when not established under conditions laid down by the F.A.I., seem apt to lend themselves to controversies. A discussion has already commenced as to whether this French flight has beaten the record set up by Mollison or not. Mollison started from Lympne, which is 200 miles further from Capetown than is Le Bourget, but, none the less, the French machine covered 6,562 miles, as against the 6,255 miles of the "Puss Moth." The Frenchmen also took about 22 hours less for their flight. As against that, Mollison flew alone, and that is a very great handicap, far outweighing the extra pounds of the navigator. There is, therefore, no direct comparison possible between the two flights. Each deserves its own credit, and we prefer to leave the matter at that. Both records may be broken before long, and if they are we shall not feel unduly excited. What we want is a speeding up of the air mail.

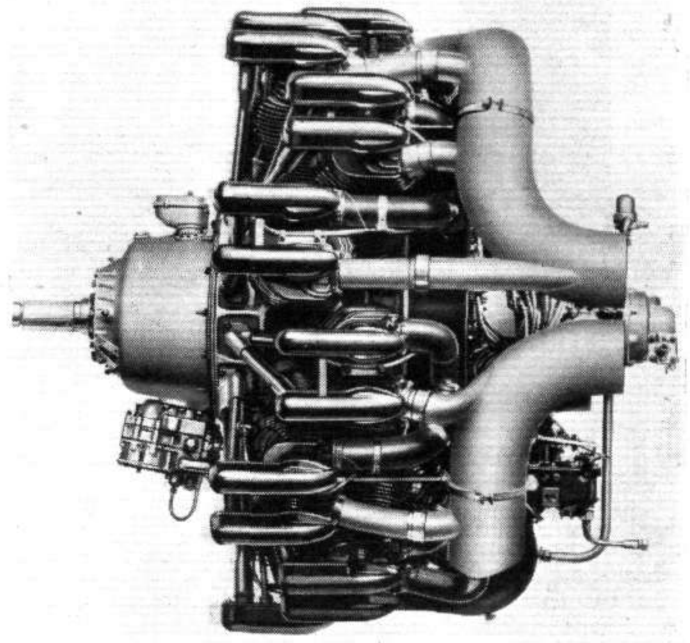
Armstrong-Siddeley "Leopard IIIA"

Rated at 800 b.h.p. at a speed of 1,700 r.p.m. and an altitude of 1,500 ft. above sea level, the new "Leopard" engine produced by Armstrong-Siddeley Motors, Ltd., of Coventry, is the most powerful air-cooled engine in this country, and possibly in the world. The "Leopard" engine has been in existence for several years, and has undergone the usual development since its inception, having now reached the series III stage, which is the type illustrated here. The principal alterations in the design are the fitting of two instead of four valves per cylinder, and the enclosing of push rods as well as rocker arms in oil-tight covers. Thus, in the latest "Leopard" the arrangement of the valve gear is very similar to that employed in the "Jaguar Major" or "Panther" engine.

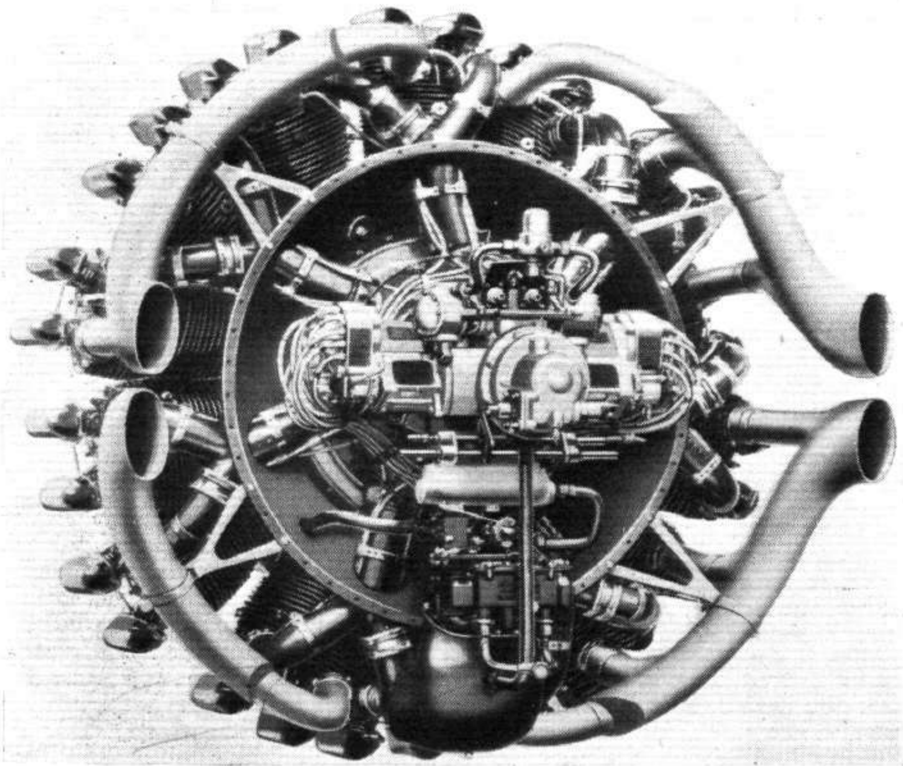
A certain amount of re-designing of the cylinders has taken place, and this, with the other improvements, has resulted in a very material saving of weight. Including the weight of the collector ring, this saving amounts to no less than 150 lb. When we say that this weight saving has been accompanied by a considerable increase in power, it will be seen that the new "Leopard" engine is a power plant likely to find many applications in the near future, the general tendency being towards greater and greater power in each individual engine unit.

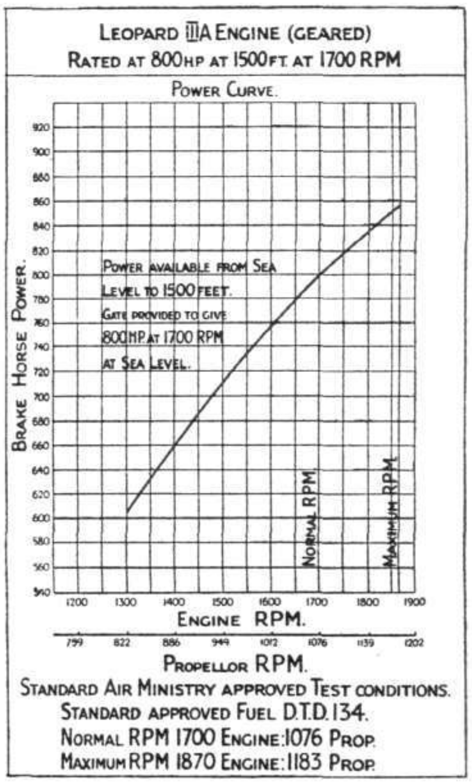
The rocker gear of the "Leopard IIIA" has been very carefully thought out. The rocker arm runs on ball bearings, and with a view to reducing valve guide wear, there is a roller at the valve stem end, which also runs on roller bearings. At the push-rod end a spherical cap is inserted in the tip of the rocker. In conjunction with the anchoring of the rocker bracket on the cylinder in such a way as to ensure constant clearance between the rocker tip and valve stem, this feature considerably reduces wear and the need for adjustment. At the same time, the rocker covers are quickly detachable to facilitate lubrication of the bearings and the necessary adjustment for clearance.

The illustrations show the beaten steel exhaust collector, which is made in four sections, two taking the exhaust from three cylinders and two taking it from the remaining four cylinders. By this division of the collector, the accessibility is improved and distortion due to heat stresses avoided.



THE ARMSTRONG-SIDDELEY "LEOPARD IIIA": Side view, showing the enclosed push rods and rocker arms. Above the reduction gear can be seen the breathers, while below it are oil pump and filter.





REAR VIEW OF THE "LEOPARD IIIA": Note the compact arrangement of the accessories. The magnetos are placed one on each side of the crankshaft, with the oil pumps above. Between the oil pumps are the two shafts for the gun interrupter gear, while the hand starter shaft projects from the casing below the pumps. Provision has also been made for fitting a gas distributor. Below the hand starter gear is the oil-jacketed mixing chamber, and below that again the Claudel Hobson twin carburettors. On the right, power curve, etc.

From Paris to Cape Town in 3¾ Days

Goulette and Salel Accomplish the Journey in Record Time

THE FARMAN 190 : It was on a similar type of machine to this, fitted with a 300-h.p. Lorraine engine, that Goulette and Salel accomplished their flight from Paris to Cape Town in 3¾ days.

THE two well-known French airmen, MM. Goulette and Salel, who last November flew from Paris to Madagascar in 4 days 8 hours, and back to Paris the following month in 5 days, have just added another achievement to their list of long-distance flights. This time they have entered the sphere of aerial activity previously tackled by British pilots and machines, viz., from Europe to the Cape. Flying a similar route to that recently taken by Mr. J. A. Mollison when he flew from Lympne along the West Coast of Africa to the Cape in 4 days 17 hours 19 minutes, the French airmen, starting from Le Bourget, accomplished the journey in 3 days 17 hours 15 minutes.

It should be noted that the distance from Lympne to the Cape *via* this West Coast route is about 200 miles longer than from Le Bourget, although some reports state that the Frenchmen actually flew a greater distance than Mollison.

The two French airmen, Salel piloting and Goulette acting as navigator, left Le Bourget, in a Farman 190 monoplane (300 h.p. Lorraine air-cooled radial), at 5.25 a.m. on April 17, and apparently flew non-stop to Colomb Bechar, Morocco, about 1,250 miles.

Their next hop was across the Sahara to Niamey, a little over 1,300 miles. Following this they accomplished another long hop of nearly 1,500 miles to Point Noire, French Gabon, and next they proceeded to Walvis Bay, another 1,300 miles, where they arrived at 1.50 p.m. on April 20.

Two hours later they resumed their flight, and later the same evening they were seen over Port Nolloth, about 360 miles from Cape Town. Round about midnight they reached Cape Town, where a large crowd was waiting to welcome them. Then, in the early hours of April 21, they landed by the aid of the aerodrome floodlights, as the enthusiastic crowd sang the "Marseillaise."

As soon as they got out of their machine they were mobbed by the crowd, and police had great difficulty in escorting them from the aerodrome to their hotel. They stated that they had encountered head winds throughout from Paris, and but for this would have reached Cape Town some eight hours earlier.

A tribute to "Shell" organisation has been made by Goulette in the following telegram he sent to Shell-Mex & B.P., Ltd. :—

"Connaissant bien l'excellence de l'organisation des depots Shell pour l'avoir apprécié au cours de plusieurs raids, j'ai pris le départ de Paris pour Cape Town sans avoir fait aucun arrangement spécial pour les ravitaillements persuadé que j'étais que de toutes les escales quels qu'elles soient je pourrais acheter de l'essence et de l'huile Shell de la même manière qu'au cours d'une promenade en auto. Le résultat de notre raid a complètement justifié ma confiance dans le service de Shell aviation puisque nous avons réussi la liaison Paris-Capetown en 3 jours 17 heures 15 minutes.—GOULETTE."

SCOTT'S ENGLAND-AUSTRALIA FLIGHT

Only 500 Miles (at the Time of Writing) to Beat the Record

BY the time this issue of FLIGHT is in the hands of our readers Mr. C. W. A. Scott will, we hope, have succeeded in bettering the 9 days 2 hr. 29 min. for a flight between England and Australia established last year by Mr. C. A. Butler, in a Comper "Swift" (Pobjoy "R" engine). At the time of writing Mr. Scott was about to take off from Koepang on the last 500 odd miles to Port Darwin and was eight hours ahead of the previous record. He is flying the same "Gipsy Moth" he used on his previous record flight, and we give below his daily progress up to the final stage—for the result of which we, unfortunately, must wait until our next issue.

As reported last week, Mr. Scott left Lympne at dawn on April 19, and flew non-stop to Brindisi. After a stop for refuelling he proceeded to Aleppo, where he arrived at 7 p.m., April 20. He took off at 1.15 a.m. the next morning, and when he arrived at Baghdad later he was a few hours ahead of C. A. Butler's time. Continuing almost immediately he pushed on to Basra, encountering dust storms and head winds which delayed his arrival there until late afternoon.

He set out again at 2.30 a.m., April 22, and reached Karachi early on April 23, leaving again an hour later for Jhansi. From here he flew to Calcutta, having flown across India in one day.

From Calcutta he flew to Rangoon next day, April 24, and left again almost immediately for Singapore, where he arrived on the evening of April 25. He was then 800 miles ahead of Butler's record. Batavia was reached the following morning, and after a brief halt he continued on to Sourabaya.

When he reached Sourabaya Mr. Scott looked tired and exhausted, but when he took off at 6 a.m. on April 27 for the final section he was in good spirits and confident of winning back the record. He reached Koepang 1 hr. 40 mins. later, where he indulged in a short but well-earned rest before taking off for the sea trip to Darwin.

The log of Mr. Scott's flight, compared with that of Mr. Butler's, is as follows (Scott started on April 19 ; approximate distances in miles shown in brackets) :—

	Scott.	Butler.
1st day	Brindisi (1,100).	Naples (950).
2nd day	Aleppo (1,000).	Athens (550).
3rd day	Basra (750).	Baghdad (1,200).
4th day	Karachi (1,230).	Jask (960).
5th day	Calcutta (1,350).	Jhansi (1,270).
6th day	Rangoon (640).	Akyab (970).
7th day	Singapore (1,000).	Victoria Pt. (800).
8th day	Sourabaya (1,000).	Batavia (1,270).
9th day	Koepang (800)—	Koepang (1,260).
10th day		Darwin (530).

The Bossoutrot and Rossi Record

The Blériot 110 Zappata monoplane as used by Bossoutrot and Rossi in their recent world's record flight (distance, closed circuit).

WITH the return of Bossoutrot and Rossi to Paris we are able to give some interesting details of their second World's Record Continuous Flight, over a closed circuit, centring around Oran, Algiers, when they covered 10,605 km. (6,590 miles) in 76 hr. 35 min. on March 23 to 26 last. Their machine had been christened *Joseph Le Brix*, in honour of the late regretted French pilot who was killed in a crash last year.

Bossoutrot and Rossi used the same well streamlined Blériot Zappata monomotor monoplane, the 110, as they did in their successful flight on February 26-March 1, 1931, when they flew 8,822 km. (5,482 miles) in 75 hr. 23 min. over the same closed circuit and thus established world records for both distance and duration—both of which records have since been surpassed. On this last flight Bossoutrot, however, replaced the 600-h.p. direct-drive Hispano-Suiza water-cooled engine originally installed with a 500-h.p. geared water-cooled engine of the same make. A four-bladed wooden airscrew was also fitted instead of the two-bladed airscrew with which the 600-h.p. engine was equipped.

During the flight just finished the Blériot plane carried 7,020 litres (1,560 gall.) of petrol, which compared with 6,250 litres (1,390 gall.) transported in the record flight of last year. Of this 7,020 litres approximately two-thirds (about 4,680 litres) were carried in tanks installed in the fuselage, just aft of the motor, while the remainder of the fuel was placed in the reservoirs lodged in the centre section of the wings.

The airmen took off from the Senia aerodrome (Oran) at 6 o'clock on the morning of March 23 last, and, being favoured with good weather conditions, maintained an average speed of 146 k.m.h. (90.7 m.p.h.) for the first 60 hr. Strong head winds, accompanied with rain squalls, then came up, which reduced their speed to an average of about 120 k.m.h. (74.5 m.p.h.) during the remainder of the flight. "At times," Bossoutrot declared on landing, "the plane only covered about 90 k.m.h. (56 m.p.h.)."

The 500-h.p. Hispano-Suiza motor consumed 6,440 litres (1,431 gall.) of petrol and 130 litres (approximately 30 gall.) of lubricating oil during the 76 hr. 35 min. in flight. About 200 litres (44 gall. approximate) remained in the tanks at the finish, the balance being lost by evaporation or leaks. A r.p.m. of about 1,950 was used at the beginning of the flight, when the plane was heavily loaded, which speed was gradually reduced until at the end the engine was only turning at about 1,400 r.p.m. The average consumption of petrol varied from 130 litres (30 gall.) per hour at the start to 51 litres (11 gall.) at the termination of the flight.

The Blériot 110 plane was described in FLIGHT for March 13, 1931, and with the exception of being equipped with a motor of a different h.p. and another type of propeller no changes have been made in the plane since Bossoutrot established his record a little over a year ago.

The 500-h.p., 12-cylinder, water-cooled "V" (60) engine used in this last flight is one of the recent models produced by the Hispano-Suiza Co. It has been approved by the Service Technique at 500 h.p. nominal power, but gives a maximum power of 640 h.p. ; the r.p.m. is 2,200. The bore and stroke are 130 mm. and 170 mm. respectively, with a compression of 7 : 1. The cylinders have a niturated steel lining. The weight of the engine empty, the propeller hub included, is 390 kg. (860 lb.), and together with the reduction gear it weighs about 430 kg. (948 lb.). The crank case is made of electron, the magnesium aluminium alloy, which effects a considerable saving in weight. The fuel consumption is 200 grams per h.p./hr. and that of oil 5 grams per h.p./hr.

An Hispano-Suiza type reduction gear with ratio of 2 : 1 was fitted to this engine for this last Bossoutrot flight.

This Blériot Zappata has been especially designed for long-distance flights. It has a flight radius of over 12,000 km. (7,500 miles) in calm air, and Bossoutrot and Rossi confidently expect to establish some additional new records this coming season. It is interesting to recall that the straight-line continuous flight record is now held by the American airmen Boardman and Polando, who flew from New York to Istanboul, Turkey, during July, 1931, a distance of 8,065 km. (5,011 miles).

On their return to Paris a few days ago Bossoutrot and Rossi announced that they hoped, with the permission of the Air Ministry, to take their plane to New York and from there make a long-distance flight across the Atlantic and then over Europe in an attempt to establish a new long-distance record. They have also several other projects in view.

R. C. W.

The Egyptian Air Force

THE recent difference of opinion with the Egyptian Government has led to the resignation of Air Commodore A. G. Board, C.M.G., D.S.O., who retired from the Royal Air Force last September and was appointed Director of Egyptian Aviation. The Egyptian Flying Corps purchased as a nucleus two Avros and five "Moths." The Avros were flown out to Egypt last March. The Egyptian Government desired that three Egyptian officers who had been trained as pilots in England should fly three of the "Moths" out to Egypt. Air Commodore Board reported that the weather forecast made it inadvisable to fly the "Moths" out, especially as the pilots had only recently completed their training. He had the "Moths" packed and sent off by sea. The Egyptian Government evidently wished to gain kudos by having the machines flown out by Egyptian pilots, probably also remembering that the first consignment of "Moths" for the Iraq Army was flown out to Bagdad by Iraqi pilots, led by a R.A.F. officer. The cases containing the machines were therefore ordered back from Gibraltar, and they have arrived at Stag Lane for the machines to be re-erected. They will be flown out by Egyptian pilots led by Flt. Lt. S. J. Stocks, of the Reserve of Air Force Officers, who has been appointed chief instructor to the Egyptian Army Air Force. Air Commodore Board has resigned his post as Director.

Indian Air Force

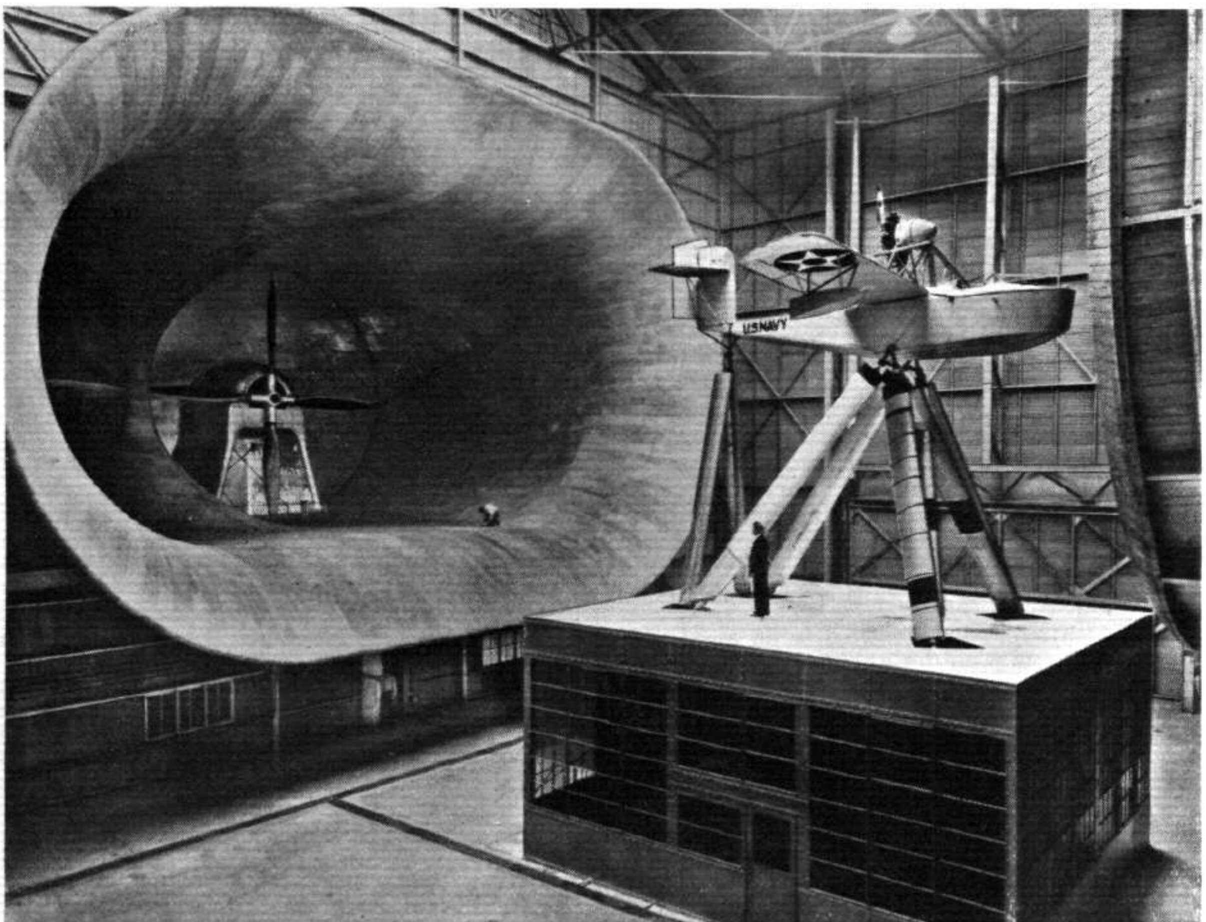
THE Air Force Bill was passed by the Indian Legislative Assembly at Delhi on April 4.

A British Full-Scale Wind Tunnel

WORK has been commenced at the Royal Aircraft Establishment at Farnborough on what will be the largest wind tunnel in Great Britain. The new tunnel will be large enough to test, at any rate the central portion of a full-sized aircraft, although it would seem that an allowance will have to be made for the lift and drag of the outer wing portions, at least for all but very small aircraft. The problems of scale effect, although by now well realised, have not been altogether solved, and sometimes it is found that the scale effect is of opposite sign to that expected. This is particularly so with certain thick high-lift wing sections. The new tunnel should be a very great help in obtaining the full-size characteristics of such shapes about which any doubt exists, and also for ascertaining interference effects between different parts of the aircraft, the effect of airscrew slipstream being included.

The wind tunnel is to be constructed in steel and reinforced concrete, and the whole installation will be housed in a building 230 ft. long, 140 ft. wide, and 90 ft. high. The tunnel itself will virtually consist of a large steel tube between 400 ft. and 500 ft. long, bent back on itself so as to make a closed circuit through which air is forced by a large fan driven by 2,000-h.p. engines. One section of the tube will be cut away for a length of 45 ft., to form the actual experimental chamber in which the aircraft to be tested is supported on measuring balances. This portion of the building will form a hermetically-sealed chamber, through which passes the air stream at speeds up to 100 m.p.h. Generally speaking, it would appear, the new wind tunnel to be erected at Farnborough will be similar to, but a good deal smaller than, the largest wind tunnel recently installed at Langley Laboratory, in the United States. A photograph of this tunnel is given herewith. The size of the air stream in which aircraft is suspended is 60 ft. in width by 30 ft. in height, so that machines up to some 50 ft. span or so can be tested complete, with engines running. The air stream in the British Tunnel will have a diameter of something like 25 ft.

It is interesting to note that the work of constructing the British full-scale wind tunnel has been entrusted to Boulton & Paul, Ltd., of Norwich. This is the only British firm which, in addition to being aircraft designers and constructors, is also well known as structural steel engineers, and so the choice was obviously a very natural one. A particularly high degree of accuracy is necessary in the construction, but with their experience of working to limits of a few thousandths of an inch in the long girders of R.101, Boulton & Paul are not likely to be daunted by this task.



THE AMERICAN COUNTERPART : The full-scale wind tunnel at Langley Laboratory gives an air stream 60 ft. wide by 30 ft. high. One of the 35-ft. diameter four-bladed airscrews can be seen. It is driven by an electric motor of 4,000 h.p. The aircraft is supported on a six-component balance. *(Photo. by Courtesy of N.A.C.A.)*

Busk Studentship in Aeronautics

A VACANCY having arisen for the Busk Studentship in Aeronautics for the year 1932-33, the Trustees hope to make an appointment towards the beginning of July next. This Studentship has been established in memory of Edward Teshmaker Busk, who in 1914 lost his life while flying an experimental aeroplane. The Studentship is of the value of about £150, tenable for one year from October 1 ; but a student may be re-appointed on the same terms for a second year. It is open to any man or woman being a British subject and of British descent who has not attained the age of 25 years on October 1 next. Forms of application for the Studentship can be obtained from Prof. B. Melville Jones, Engineering Laboratory, Cambridge, and must be filled up and returned to him not later than May 12 next.

PRIVATE FLYING & GLIDING

TO GUIDE THE PILOT

Why not paint the roofs and/or walls of your aerodrome buildings yellow?

How often, even in these days of numerous holders of navigators' licences, do we hear of pilots passing quite close to an aerodrome without seeing it? It generally happens that he has not been there before, of course, but the fact remains that when the visibility is bad many aerodromes are difficult to locate easily. If their buildings are painted white or yellow, however, they can be seen from many miles away, and the adoption of the yellow roof by all aerodromes would, if it became a standard practice, assist pilots greatly.

At Desford, the aerodrome of the Leicestershire Aero Club, the buildings have already been painted white, with the result that even when arriving at "closing time" as we did recently, their place is simple to pick out from a long way away. Heston is another aerodrome where the light coloured buildings are helpful, but at far too many others they harmonise with the surroundings to such an extent that one would think they were dependent upon camouflage for their very existence.

Let owners realise that being helpful brings them more visitors—this applies to municipal aerodromes in particular—and making their aerodromes visible from a distance is one way in which this can be done.

We understand that at least one well-known manufacturer of outside "finishes" is ready to supply a suitable finish for the purpose, and we suggest that all flying clubs and aerodrome authorities should consider the advantages they would give their flying visitors by carrying out this idea.

ANTWERP AVIATION CLUB

A Display of British aircraft is being held at the Antwerp aerodrome, Deurne, on Saturday, May 7. A large number of firms are co-operating, including the de Havilland Aircraft Co., Ltd., the Standard Telephone & Cable Co., Ltd., Brian Lewis & Co., Ltd., the Fairey Aviation Co., Ltd., Arrow Aircraft (Leeds), Ltd., and the Redwing Aircraft Co., Ltd.

Stampe & Vertongen (Antwerp), the agents in Belgium for the de Havilland Co., will be given instruction in their "Gipsy Moth," which has been fitted with a wireless-receiving set. Members of the British Embassy are flying from Brussels to Antwerp in one of the "Sabena's" "Westland Wessex," and the local air-taxi company, "Aéra," will be joy-riding with a "Desoutter." The Display is being organised jointly by the Antwerp British Colony Association and the Antwerp Aviation Club, and inquiries should be addressed to Mr. Rex Newman, 19, Avenue Cogels, Antwerp. We are asked to point out that visitors arriving on Saturday should do so not later than 2 p.m., as the aerodrome will be reserved exclusively for the machines participating in the demonstration from 3 p.m. to 5 p.m., while, if possible, it would help the management if visitors arrived before noon.

THE HOUSEHOLD BRIGADE FLYING CLUB

Over 223 flying hours were completed on aircraft of the Household Brigade Flying Club during 1931. This club is becoming very strong, and now has 25 licensed pilots, including 12 serving officers, 19 non-serving and 4 members of the ladies' section, while 16 members possess 23 privately-owned aircraft between them. All serving officers of the Brigade of Guards are automatically members through their joint sports arrangements, and there are also in addition 65 non-serving officers. The 1932 annual flying meeting will take place at Heston Airport on Wednesday, May 18, when all private owners and their friends will be welcome.

THE SCOTTISH FLYING CLUB

Although there were only five days during February which could be called perfectly O.K. from the flying point of view, the club machines flew some 133 hr. 30 min., of which 39 hr. 5 min. were solo by "A" licensed pilots. This compares very favourably indeed with the 71 hr. 25 min. for the same month of 1931. The transference of the City of Glasgow (Bombing) Squadron of the A.A.F. to Abbotsinch aerodrome has raised fears that the Scottish Flying Club might not be able to continue at Moorpark. These fears, however, would, according to the latest reports, appear to be unfounded, as the Town Council have already under consideration the establishment of a municipal airport, and would therefore be unlikely to allow a club to fail for want of an aerodrome.

READING

F/O. J. Lawn has now joined the staff of the Phillips & Powis School as an instructor. Both the blind-flying course, and the series of lectures organised by Com. C. W. Croxford, have proved a great attraction at the school and have been "running to capacity" since their inception. Sir Alan Cobham's organisation visited the aerodrome on Wednesday last, April 20, and drew a crowd of many thousands to the aerodrome. One of the outstanding events of the display was F/O. Turner Hughes' performance of inverted flying in a "Tiger Moth."

Attractive though modern ; is our verdict of the new Brooklands Aero Clubhouse. This rear view shows to advantage its clean lines and spacious approach. (FLIGHT *Photo.*)

BROOKLANDS

Among the new pupils who joined Brooklands School during the last week were Mr. Ritchie, who has been in India for some years and hopes to take his "A" licence before returning there; and Mr. N. P. Gadgil, who has flown extensively at Karachi and has now come home with the intention of taking his "B" licence.

The blind flying course is proving a great attraction and it is expected that before very long everyone who learns to fly at Brooklands will also take this course.

Arrangements for the sale of tickets for the Civil Air Display which is taking place on May 27 and 28 have been put in the hands of Keith Prowse, Ltd. Tickets will also be obtainable through all the flying clubs, the Royal Aeronautical Society, and the Air League, etc., on May 1. The catalogue of the Display, which is being produced by Gale & Polden, Ltd., is, in view of the international character of the meeting, likely to be a valuable

advertising medium, and in order to cover their expenses with this production, the Display authorities would be glad to hear from any publicity managers desirous of co-operating.

The Press Aero Club are having a special day at Brooklands on May 16, when the B.A.R.C. has offered honorary membership to all journalists attending. Several members are now ready to go solo, and it is hoped to recruit many more on this day.

The new shop, the opening of which we mentioned recently, is proving that an institution like this has long been wanted at Brooklands. Mrs. Davis and Miss Beer are now kept busy throughout the whole day, and there is very little that members (male or female) can want in the way of wearing apparel which cannot be supplied. An innovation started in "The Shop" last week was the supply of coffee, and while we do not suggest that the club is going dry, yet there is no doubt that the size of their sales of this beverage point to the fact that most people prefer delaying the consumption of stronger drink until late in the day. At the present moment the majority of the wearing apparel is sold directly over the counter, but arrangements are being made whereby the back room is being turned into a fitting room, and here the privileged will be able to try on their purchases before committing themselves.

On Saturday, April 23, the Brooklands Aero Club held an impromptu dance by way of unofficially opening the new clubhouse. This attractive building, which has already been illustrated in our pages, has been built to the design of Mr. Graham Dawbarn, and certainly constitutes the most up-to-date and modern clubhouse of any in the country. So palatial is it and so well arranged that it really comes in the category of an airport station rather than a clubhouse, but the last thing Brooklands wish is that their aerodrome should be looked upon as an airport. Notwithstanding this, however, their building is surmounted with a very fine control tower and the installation of floodlighting at the aerodrome is probable. English people have been brought up to the idea that buildings to be attractive must be old. Mr. Dawbarn's structure, however, disproves this theory, and by the generous use of colour, combined with an openness and freedom of treatment, together with adequate lighting, he has achieved the most cheerful building we have seen for a long time. It is only just being realised that some colours definitely produce a nervous reaction on people, and there is no doubt that the rich buff and orange colour scheme at Brooklands is largely responsible for the invariable air of cheerfulness which is to be found there. Saturday evening proved this to the full, and it was quite a change to go to a dance where half those on the floor did not have set faces full of steadfast purposefulness; during our visit, in fact, it is no exaggeration to say that we did not see one "long face." The provision of such an attractive and well-run social side to a flying club like this must go a long way to keeping it going during the somewhat dead winter and early spring season when fog and low cloud make flying impossible.

The Silvertown Trophy which will be raced for on a formula under rules of the Aero Club of India and Burma. The control points will be the same as those for the Viceroy's Challenge Trophy.

DISPLAY AT WHEATHAMPSTEAD

This Display, which is being organised in conjunction with the newly-formed Hertfordshire Flying Club, of St. Albans, takes place in connection with the Hospitals Charities of Wheathampstead, Herts, on Whit Monday, May 16.

The programme is a mixed one, consisting of a Flying Display in the morning from 10.0 a.m. and a Mounted Gymkhana afterwards.

This Club has for Chairman and President The Hon. Mrs. Faulconer (Lord Knutsford's daughter). Vice-Chairman, The Hon. John Grimston. Hon. Secretary and Chief Instructor, Mr. V. N. Dickinson. Temporary headquarters, The Peahen Hotel, St. Albans.

The Flying Display has the kind assistance of the de Havilland School of Flying, Hatfield.

Any private owners who would like to attend will be made very welcome and are requested to land at Hatfield Aerodrome. The R.A.F. Band and Pipers from Halton will play during the Display. The R.A.C. are arranging the car park.

LONDON TO NEWCASTLE AIR RACE, MAY 28

Entries for the above race must be in the hands of the Hon. Secretary, Newcastle Aero Club, Ltd., Cramlington Aerodrome, Northumberland, not later than 5 p.m., May 10. Late entries will be received until 12 (noon) on May 20, 1932, at a fee of £5 5s. per machine.

CINQUE PORTS FLYING CLUB

An additional attraction is promised for the Display which is being held at Lympne on Saturday, April 30, in the shape of No. 25 Fighter Squadron, who will give a demonstration of formation flying with their Hawker "Furies"

The number of applications which have already been received for the dinner and dance would appear to ensure the success of this event, and what was originally intended to be a small, somewhat informal affair, has now grown into large proportion.

Among those who have recently undertaken the course of night flying are the Hon. Mrs. Victor Bruce and Miss Aitken. Another lady who has joined with the intention of obtaining her "B" licence is Miss Winifred Drinkwater. This latter is one of the first ladies from the Scottish Flying Club to try for her "B" licence, and her flying to date is a credit to the instruction she received there. Arrangements are now in progress for taking over a country house close to the aerodrome which will be used as a Dormy house. This house will have accommodation for about 12 guests.

The Stinson Junior which Mr. Cathcart-Jones is flying round Spain for his employer, Mr. James, is here seen by the N.F.S. workshops at Hanworth. (FLIGHT *Photo.*)

AIRPORT NEWS

CROYDON

APRIL showers during the week at last brought forth a fine week-end. Saturday and Sunday saw intensive flying from morning to night, good business being done all round. Saturday morning we were crowded out with North country visitors up for the Cup Final. Streamers, rosettes and scarfs seemed to be the order of the day. In spite of the supposed depression in the North, several hundred of the visitors found the necessary cash to indulge in joyrides, and all companies, including Imperial Airways, added materially to their coffers. The hotel bar also participated in record trade.

The Prime Minister travelled to Paris on Wednesday in a Fairey 3F escorted by two other Fairey 3F's. His departure was made in very unpleasant conditions; pouring rain and high wind.

Several "B" licence candidates have been undergoing their tests over the week-end, amongst them being the Hon. Mrs. Victor Bruce, Miss Drinkwater and Miss Aitkin. There seems to be a plethora of candidates all at once.

Mr. Wilcockson, of Imperial Airways, has returned after being out East for quite a long period, so one presumes he will shortly be flying on the European services once more.

Monday, May 2, will see the commencement of the full summer services, which is scheduled to continue up to October. The Royal Dutch Air Lines are this year operating a semi-night service which will leave Amsterdam at 4.40 a.m. daily. This company also have a sunset service which leaves Croydon for Holland at 7 p.m. Imperial Airways and Air Union have three services each way on the Paris route daily, except Sundays, when two each way will operate for Imperial and one for Air Union. All these services, of course, are subject to duplication or triplication when necessary, which should be very often this coming summer, judging by present passenger traffic. Sabena Air Lines have two services each way daily, which will later be supplemented by evening services to and from Le Zoute and Ostend.

The traffic figures for the week were:—Passengers, 902; freight, 41 tons.

P. B.

FROM HESTON

MONDAY, April 18.—Lord Grimthorpe cleared Customs and left for Brussels in his "Puss Moth." Three private owners arrived back from Paris and one from Jersey.

TUESDAY, April 19.—Four new pupils commenced instruction on this day, and since then no day has passed without new pupils either commencing instruction or, if the weather was not suitable, booking appointments ahead.

Mr. Noel Guinness cleared Customs inwards on arrival from Paris, as did Maj. Alan and Mrs. Butler, while Capt. Max Findlay brought a passenger, all in "Puss Moths."

Mr. Trafford, with his mother, arrived from Geneva in his "Moth."

Mr. Styran, of B.A.N. Co., left in a "Puss Moth" for Reval (Tallin), *via* Königsberg, where he arrived on Wednesday evening. His passenger is Mr. Beech, who is visiting the Soviet Government at their invitation. They are returning *via* Warsaw and Berlin.

WEDNESDAY, April 20.—Capt. J. C. Hargreaves, Grenadier Guards, in his "Klemm," cleared Customs and set off for Cairo with Mr. R. L. Hare, Coldstream Guards, as passenger. The latter is joining his battalion at Cairo and Capt. Hargreaves is flying home again.

Mr. Whitney Straight arrived from Munich, and Lord Grimthorpe from Ostend, both in "Puss Moths." Mr. "Tony" Law, son of the late Mr. Bonar Law, arrived in his "Widgeon."

THURSDAY, April 21.—Mr. Mark Lacayo, of the Lancashire Aero Club, cleared Customs and proceeded to Brussels in a Comper "Swift." He is making an extended tour of the Continent during the next two months.

Sqd. Ldr. D. V. Carnegie, A.F.C., cleared Customs and left for Berlin and Poland.

FRIDAY, April 22.—Mr. J. Walker took delivery of a new "Puss Moth" from Brian Lewis & Co., Ltd.

Mr. G. N. Wilson made a business trip to Liverpool in a Shell-B.P. "Avian."

Flt. Lt. Russell cleared Customs and left in a "Redwing" for Rotterdam.

Capt. Crossley and Mr. Mitchell arrived from Baldonnel in an "Avian" (EI-AAB).

SATURDAY, April 23.—Mr. Kenneth Crossley, Bt., flew down from Cheshire in his "Moth" to meet his daughter, Miss Fidelia Crossley, at Heston. Miss Crossley had arrived the previous day from India, having flown by Airline from Marseilles to Croydon.

Mr. Geoffrey Mahony cleared Customs and started off on his journey to Baghdad in an Airwork "Puss Moth." Mr. Mahony is to inaugurate the passenger service in Iraq, which is now being arranged by Mr. Alan Muntz, of Airwork, Ltd.

SUNDAY, April 24.—Capt. C. D. Barnard, in his "Fokker" G-EBTS, arrived back from Amsterdam and Mlle. Lippens—with one passenger—cleared Customs, and left in her "Puss Moth" OO-AMN for Antwerp.

Three new pupils commenced instruction to-day, one of whom was Col. the Viscount Gort, V.C., commanding the Grenadier Guards and 4th Guards Brigade.

Flt. Lt. Russell arrived back from Rotterdam.

Among the entries for the *Morning Post* race, to be held on May 21, is one from a member of the Japanese Embassy, so that the race has now taken on an international character. The different makes of machines are well represented among the entries, so that it should have plenty of interest.

A New Navigation Instrument

ONE of the recent important contributions to the science of navigation is the "Spherant," invented and perfected by Mr. Howard B. Kaster, who is in charge of courses in aviation and meteorology at the Boeing School of Aeronautics, Oakland Municipal Airport, California. The "Spherant" has been accepted by the Bureau of Aeronautics of the U.S. Navy Department, and is given considerable space in the training manual of the U.S. Naval Aviation Training Station at Pensacola, Florida. In spite of the fact that improved instruments and improved tables have done much to simplify the work of navigation, celestial navigation will always require the solution of the spherical triangle. This has formerly been worked out mathematically with the aid of computation tables or mechanical calculating devices, and a long period of technical training in mathematics and astronomy, as well as much practical experience, was necessary for proficiency as a navigator. The "Spherant" makes possible the solution of the spherical triangle mechanically, just as the better known slide rule solves problems in multiplication or division mechanically. This does away with the long period of technical training formerly required and minimises the possibilities of error. The "Spherant" gives the desired quantities directly and no complicated tables, except the Nautical Almanac, are necessary. The triangle is solved mechanically during the observation. The "Spherant" is said by an officer of the Naval Academy to be "the most revolutionary and progressive idea to be developed since Captain Sumner laid down the first line of position in 1837." Mr. Kaster, in his development of the "Spherant," has done considerable work with the navigating and air officers of the United States Navy, both with the fleet and at the Naval Air Station at San Diego.

AN AIR SAFETY CONGRESS

H.R.H. The Duke of York, as Patron of the National Safety First Association, will open the proceedings at an Air Safety Conference, which is being held at Croydon Aerodrome on the afternoon of Thursday, May 5, during the National Safety Congress.

This particular conference is the first work undertaken by the recently formed Air Safety Committee of the Association, the latter's educational work in connection with the prevention of industrial and street accidents is generally well known.

The Committee is composed of a representative from each of the following:—The Air Ministry, the Guild of Air Pilots, the Aviation Department of the Automobile Association, the Air League, and the British Aviation Insurance Group.

In anticipation of the very largely increased public interest in flying which may be expected during the next few years, the Committee proposes to prepare and issue safety propaganda addressed to amateur pilots, to passengers, and to the general public, indicating how each can contribute to greater safety in aviation.

The Committee will act in co-operation with the various bodies actually concerned with flying, and there is no intention of duplicating the functions of these organisations. This is the same arrangement as holds in the case of the Association's road safety campaign.

At the Croydon conference, two papers will be submitted for discussion, one by Capt. Ivor McClure, D.S.O., of the Automobile Association, upon "Air Sense," and the second by Maj. Mealing, of the Air Ministry, upon "The Service Necessary for the Safety of Aviation." The discussion will be opened by Lt. Col. F. C. Shelmerdine, C.I.E., O.B.E., the Director of Civil Aviation.

The Conference will be attended mainly by delegates from local authorities all over the country, who will later inspect the aerodrome, control arrangements, etc. Some of them will also make a short flight in one of Imperial Airways' latest air liners.

If any readers would like to attend the Conference, they should notify the General Secretary of the National Safety First Association at 119, Victoria Street, London, S.W.1, who will be glad to arrange it, if accommodation permits. As the date is Thursday next, early application is advised.

AT THE ATHENS AERO SHOW

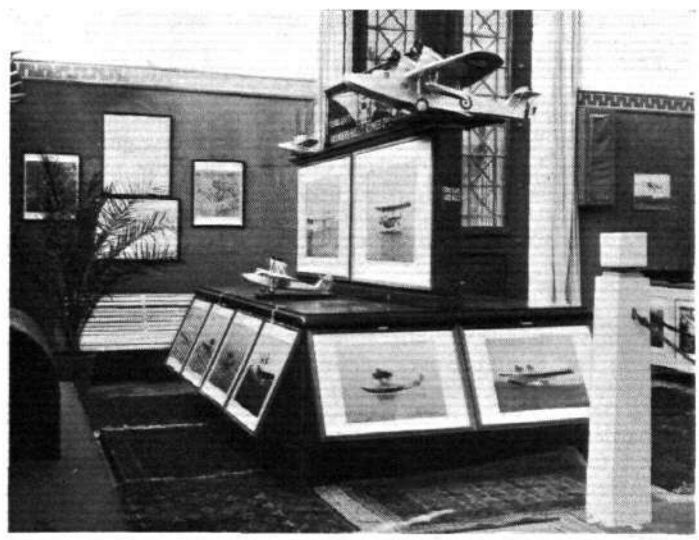
As reported in our issue of March 11 last, some 22 British firms concerned in the manufacture of aircraft, aero engines and accessory equipment, have combined to form a comprehensive exhibit in the First International Aero Exhibition at the Zappion Palace, Athens, which opened on April 1 last and continues until May 1 next.

We show in the accompanying illustrations the stands of four of these British exhibits. The first, at the top, is that of Saunders Roe, Ltd., of East Cowes, I.O.W., and it will be seen that the exhibit consists of models of the various Saro amphibian and flying-boat aircraft produced by this firm—the "Cutty Sark," the "Windhover" and the "Cloud"—together with large photographs of these machines.

Below, on the left, we show the Napier exhibit, which consists of a sectional Napier aero engine which has, we understand, given rise to considerable interest.

Next, in the centre, we have the stand of the Bristol Aeroplane Co., Ltd., of Filton, which displays photographs and parts of both Bristol aircraft and aero engines.

The last illustration, on the right, shows the stand of Cellon, Ltd., of Kingston-on-Thames, and as dopes and varnishes hardly lend themselves to show purposes this exhibit consists mainly of pictorial and graphic illustrations of the uses and successes of "Cellon" in all parts of the world.



The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

April 29, 1932

CONTENTS

THE MUTUAL INFLUENCE OF ENGINE AND AIRSCREW CHARACTERISTICS

By Lt. Col. J. D. Blyth, O.B.E., A.F.R.Ae.S., M.I.Ae.E.

(Concluded from page 23)

The value of η is affected also by the gear ratio, since this affects the value of P/D. Fig. 5, which is derived from Diehl's general efficiency curve given in N.A.C.A. Report No. 168 shows the values of $\eta_{\max.}$ for varying values of P/D, while Fig. 6, from the same source, shows the variation of η with V/nD. It will be seen that the lower the airscrew r.p.m. the higher pitch diameter ratio becomes, leading in turn to increased maximum efficiency.

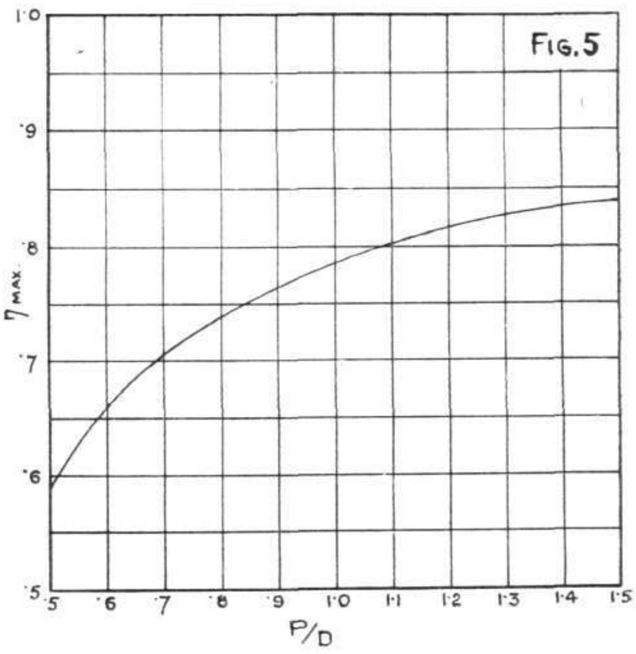


Fig. 5.—Variation of maximum efficiency with P/D.

We can return now to the case of engine B with various gear ratios. Assuming a value of parasitic drag in slipstream which is of the order obtained in practice, and employing Figs. 5 and 6, we can amplify the table as follows:—

Gear ratio.	0·5/1	1/1	1·5/1	2·0/1	2·5/1
η_M ...	0·84	0·81	0·78	0·755	0·73
$1 - S$ ...	0·96	0·92	0·88	0·84	0·8
$\eta_M(1 - s)$	0·805	0·745	0·685	0·635	0·584
$\eta_N(1 - s)$	0·79	0·73	0·66	0·59	0·528
$H.P._{T_N}$ ...	363	336	304	271	243

From this table we see that although normal r.p.m. are maintained the propulsive efficiency falls off so rapidly when the airscrew is geared to give higher r.p.m. than the engine that the thrust horsepower lost is considerable.

A third important factor which has not been taken into account is the practical limitation to the tip speed of the airscrew. As this approaches the speed of sound the compressibility of the air can be disregarded no longer, and its effect becomes more and more pronounced; and when the speed of sound is reached, energy is dissipated in the form of sound waves. In such

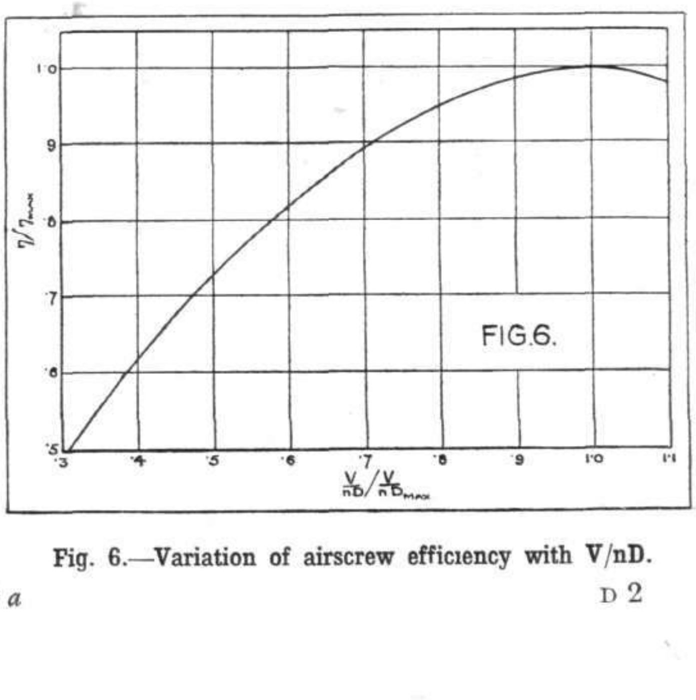


Fig. 6.—Variation of airscrew efficiency with V/nD.

dissipation of energy no useful work is done by the airscrew, and its efficiency falls rapidly.

The resultant tip speed of the second airscrew (gear ratio 1/1) at maximum forward speed and 1,950 r.p.m. is 1,014 ft./sec. This is rather higher than is desirable; and, although *in exceptional circumstances* airscrews running at a tip speed approaching that of sound are used at times, it is better to limit the tip speed when possible to 900 ft./sec.

It appears, then, that in the case of engine B the airscrew r.p.m. should be less than the engine r.p.m.

Assuming that the power curve of the engine is given by the following figures:—

Engine r.p.m. ...	1,950	1,775	1,700	1,650	1,600
B.H.P.	520	460	437	422	407

we obtain the following results at 171 ft./sec.

Gear ratio	0.5/1	1/1
Engine r.p.m.	1,660	1,680
B.H.P.	425	430
$\eta(1 - s)$	0.749	0.69
$H.P._{T_{cl}}$	318	296

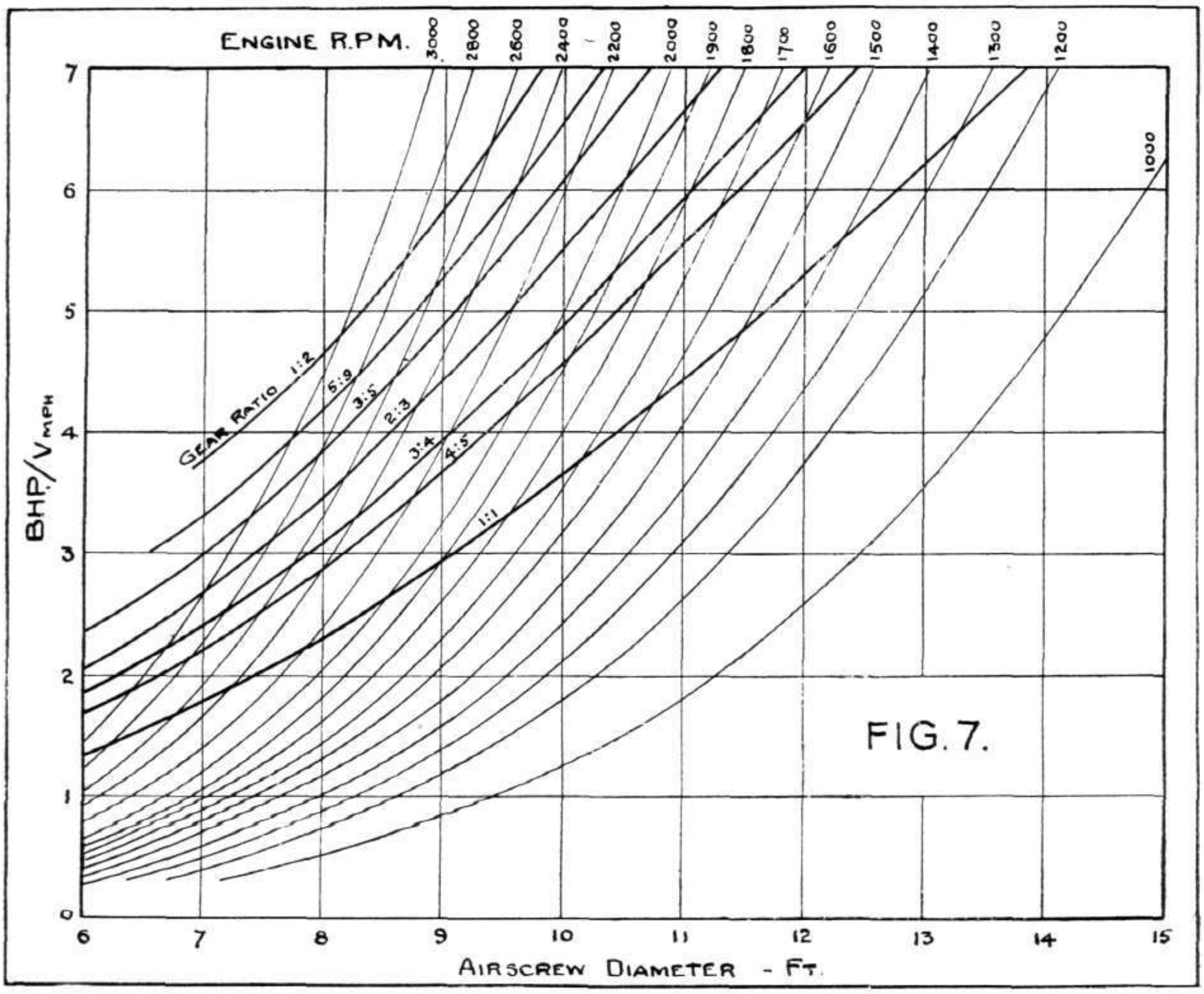


Fig. 7.—Diehl's gear ratio chart for two-bladed airscrews.

if possible, and certainly no greater; that is to say, the gear ratio should be less than 1/1.

Fig. 7 gives Diehl's Gear Ratio Chart for tip speed 900 ft./sec., published in Shoemaker's article in "Aviation" (January 19, 1929). In this chart the gear ratio is read from the suitable curve at the point where the curve of engine r.p.m. intersects the ordinate $\frac{\text{B.H.P.}}{\rho\text{V}}$ (V being in m.p.h.), and the airscrew diameter corresponding to the gear ratio so found is read at the point where the curve of gear ratio 1/1 intersects the ordinate at the same value of $\frac{\text{B.H.P.}}{\rho\text{V}}$. The speed of 900 ft./sec. for which these curves are drawn are tip speeds due to rotation only, and not resultant tip speeds which include the speed of translation. It will be seen from this chart that for the case we are considering the gear ratio should be rather higher than 4/5 and lower than 1/1.

Since it is not practicable to use such a gear ratio as will give normal r.p.m. on climb we will employ those which do not cause the tip speed to exceed the limiting value, and find the effect on the airscrew performance of the loss in r.p.m.

By employing a gear ratio of 2.5/1 and maintaining approximately normal r.p.m., the thrust horsepower on climb was only 243. From this we see that though lowering the gear ratio involves loss in r.p.m. and consequently in b.h.p. on climb, this loss is more than overcome by the resulting gain in net airscrew efficiency in the case of this particular engine.

The examples of engines taken are normal, that is to say, the slope of the curve of b.h.p. against r.p.m. lies within the average. In the case of engine C, in which 20 per cent. over-revving is allowed, an airscrew designed to give normal r.p.m. on climb will hold down the r.p.m. at top speed to less than the maximum permissible; while an airscrew designed to give maximum r.p.m. at top speed will exceed normal r.p.m. on climb *unless the engine is throttled. This indicates that the* slope of the power curve against r.p.m. could be steeper. If the slope of the power curve is not steep enough the effect is reversed.

Similar calculations will lead us to the conclusion that in the case of any particular engine and gear ratio there is only one value of the top speed for which an airscrew can be designed so that it will give maximum r.p.m. and maximum efficiency at top speed and normal r.p.m. on climb. It does not appear, however, that

except in extreme cases departure from this design condition will impair the performance of the aircraft to any great extent on account of loss of climbing r.p.m.; in fact, when this loss is due to a low gear ratio and large airscrew diameter the performance is improved.

We have not, however, considered every aspect of the case. The conclusions reached so far are applicable only to conditions at the height at which the airscrew is designed to absorb the exact horsepower of the engine. As the height increases above that at which the engine develops its maximum power the b.h.p. at constant r.p.m. falls off, with the result that the airscrew holds the engine down to lower r.p.m. and a further loss in power ensues. This is unavoidable when a fixed pitch airscrew is used, and occurs with every type of engine. There is, however, a more serious matter to be considered in the case of a supercharged engine.

Referring again to engine B, we see that the supercharged height is 10,000 ft., which is the design height of the airscrew. We must now consider what happens at ground level.

In saying that the engine is fully supercharged at 10,000 ft. we mean that the normal boost pressure is maintained at this height at full throttle. Actually, the boost pressure and consequently the height of maximum supercharge vary with the r.p.m., but as the airscrew performance is affected only by the slope of the power curve the latter is all that we need consider in our investigation.

At heights below the supercharged height the boost pressure will rise if the throttle remains fully open until at ground level; in the case of engine B it would be about 5 lb./sq. in. above normal. Consequently, at heights below the supercharged height, the engine has to be throttled down to normal boost.

It has been common practice for some time to allow a small extra amount of boost at ground level for take off; but the gain due to this is not very great. The power curve with this additional boost shows, in the case of engine B, an increase of about 60 b.h.p. at normal r.p.m. over that at normal boost and r.p.m., but this b.h.p. is not necessarily available. The throttle control is provided frequently with a gate through which the throttle lever must not pass at ground level. This gate is arranged so that when the aircraft is standing still with the engine running the airscrew holds the engine r.p.m. down to the point at which permissible boost is not exceeded. As the aircraft gathers speed the r.p.m. increase, but since the throttle lever remains in the gate the throttle is partially open only, and the boost pressure falls.

This arrangement is being superseded by the automatic boost control, which is a mechanism which opens the throttle automatically and maintains constant boost at all r.p.m.

We will assume that the engine under consideration is fitted with this control, when the power curve at ground level is given by the following:—

Engine r.p.m. ...	1,950	1,775	1,600
B.H.P.	475	440	400

Having seen how the engine power is affected by the change from supercharged height to ground level we will now proceed to examine the effect of the same change on the airscrew. In the following the subscripts 0 and 10 denote conditions at ground level and at 10,000 ft. respectively.

From equation (ii)

$$\frac{K_{Q_0}}{K_{Q_{10}}} = \frac{B.H.P._0}{B.H.P._{10}} \cdot \frac{n_{10}^3}{n_0^3} \cdot \rho_{10} \text{ (since } \rho_0 = 1)$$

whence, for constant r.p.m.,

$$\frac{K_{Q_0}}{K_{Q_{10}}} = \frac{B.H.P._0}{B.H.P._{10}} \cdot \rho_{10}$$

At the r.p.m. attained on climb at 10,000 ft., $B.H.P._0$ is less than $B.H.P._{10}$, and the value of ρ_{10} is 0.7384.

$$\therefore K_{Q_0} \text{ is less than } K_{Q_{10}}.$$

Inspection of the curves of K_Q against V/nD shows that K_Q decreases with increasing V/nD, and therefore $(V/nD)_0$ is greater than $(V/nD)_{10}$. But, since we have taken the case of constant r.p.m., nD is constant, and therefore V_0 is greater than V_{10}. In other words, a greater speed will have to be reached at ground level than at 10,000 ft. for the same r.p.m. to be maintained; and if the same speed is maintained at ground level as at 10,000 ft., the ground level r.p.m. will be less than those at 10,000 ft.

Theory and practice agree in showing that the maximum rate of climb of an aeroplane fitted with a supercharged engine occurs at a constant value of the indicated air speed up to the supercharged height. In the case of the machine we are considering the true airspeed on climb at 10,000 ft. is 171 ft./sec., from which we see that the corresponding speed at ground level is 147 ft./sec. It is obvious that the climbing r.p.m. at ground level will be very much lower than at 10,000 ft., and by calculation we obtain the following result:—

Gear ratio	0.5/1	1/1
Engine $R.P.M._{cl_0}$ ...	1,415	1,430
$\eta(1-s)$	0.753	0.642
$H.P._{T_{cl_0}}$	265	230

The advantage lies still with the lower gear, but in both cases the fall in r.p.m. below normal entails a serious loss of engine power, amounting to between 80 and 90 b.h.p. The result on the performance of the machine is that the length of run to take off is increased and the initial rate of climb is reduced.

Both may be improved by various means, of which the most common is an increase in the amount of boost allowed, for a very limited period. Usually, the increased boost falls to normal by the time the aircraft has reached about 4,000 ft., and the time taken to climb to various altitudes is reduced but little. The provision of a two-speed gear to the blower has much the same effect, and neither succeeds in allowing the full available b.h.p. of the engine to be used under all conditions.

No matter what means of this type we adopt the result will be controlled by the mutual influence of the engine and airscrew characteristics; and with a given engine and airscrew these characteristics will cause the combination to act in a fixed and unalterable way under fixed conditions of speed and atmosphere unless it is possible to vary the characteristics of the engine or of the airscrew, or of both, while working.

The engine characteristics, *i.e.*, the curve of b.h.p. against propeller shaft r.p.m., might be varied (if the mechanical difficulties could be overcome) by the provision of an infinitely variable gear between the crankshaft and the propeller shaft.

We have seen that a low gear ratio combined with a large airscrew diameter give the best results on account of the high value of the propulsive efficiency of the airscrew. With an infinitely variable gear ratio the airscrew diameter will be fixed by considerations of ground clearance for most machines. We will assume that engine B is used, and that the airscrew already considered for this engine when geared 0.5/1 is the largest possible (thereby fixing the upper limit of the gear ratio at 0.5/1), and will find the effect at climbing speed at ground level of using an infinitely variable gear ratio.

The airscrew having been designed for the maximum speed condition with a gear ratio of 0.5/1 has a value of P/D of 1.52. Its maximum propulsive efficiency is 0.805 occurring at $V/nD = 1.2$. We have now to find what gear ratio must be used to allow the engine to develop 1,775 r.p.m. at 147 ft./sec. at ground level.

Equation (xv) refers to the design condition of the airscrew, and therefore is not applicable to this case;

and to arrive at the required result we shall have to assume various gear ratios and find out at what speed each permits the engine to develop normal r.p.m. This is done as follows:—

The characteristic curves of the airscrew, *i.e.*, K_Q and $\eta(1 - s)$, are drawn in Fig. 8.

The b.h.p. of the engine is 440 at 1,775 r.p.m., and the diameter of the airscrew is 13.51 ft. If G is the gear ratio, we have, from equation (i)

$$K_Q = \frac{0\cdot001394}{G^3}$$

Evaluating this expression for various values of G, and reading from the curve of K_Q the values of V/nD corresponding with the values obtained for K_Q we arrive at the following results:—

G	...	0.422	0.424	0.426	0.428	0.43
K_Q	...	0.01856	0.01829	0.01805	0.01779	0.01754
V/nD	...	0.8	0.85	0.885	0.92	0.945
nD	...	168.8	169.6	170.4	171.2	172
V ft./sec.		135	144	151	157.5	162.5

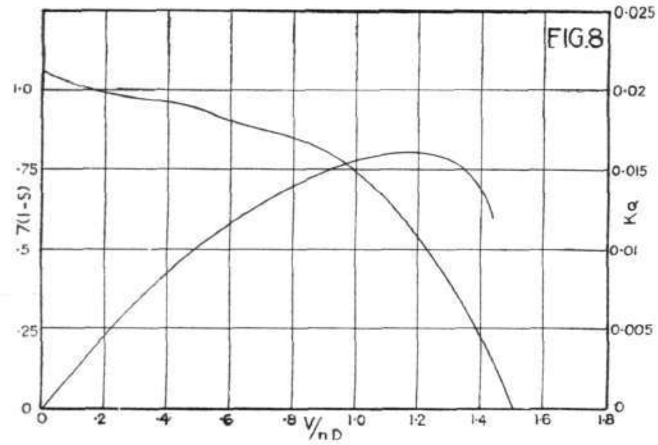


Fig. 8.—Torque coefficient and efficiency curves of airscrews investigated for engine B., gear ratio 0.5/1.

If the values of V ft./sec. are plotted against G we find that V is 147 ft./sec. when G = 0.425. The value of V/nD is 0.865, and from the curve of $\eta(1 - s)$ we see that the propulsive efficiency is 0.728. This gives 320 thrust horsepower at climbing speed at ground level, showing an increase of 55 h.p. over the case of the fixed gear ratio.

Unfortunately, the mechanical difficulties to be overcome in devising such a variable gear prevent us from increasing the thrust horsepower available at climbing speed in this way; so we cannot vary the engine characteristics by varying the ratio between airscrew and crankshaft r.p.m.

The engine characteristics might be varied by varying the b.h.p. while keeping the r.p.m. constant. As we are working up to the maximum b.h.p. available at any r.p.m. such variation can be made in one direction only, that is to say, by reducing the b.h.p. at any r.p.m. to less than the maximum possible. Since this is precisely what we are trying to find means to avoid we need not explore its possibilities any further.

The only course left open now is to vary the airscrew characteristics, and the choice of variable is limited. Two airscrews may differ in diameter, blade area, plan form, section and pitch; but once an airscrew is made it is impossible in flight to vary any of these except the last. By doing this we arrive at the variable pitch airscrew.

The performance of a variable pitch airscrew is not affected by the method of operation; that is to say, the pitch may be altered automatically or by hand-operated gearing to obtain the required r.p.m. In practice the automatically-operated variable pitch airscrew has the great advantage that once the control is set to any desired r.p.m. the governor will cause the pitch to be adjusted to suit fluctuations in air speed or engine power far more rapidly than is possible with any hand-operated gear, and the r.p.m. will remain to all intents constant.

The ideal variable pitch airscrew would be one in which the blades not only would be turned through the necessary angle to vary the pitch, but also would be twisted along their length to preserve the helix. This is impossible, and therefore, for values of the pitch other than that for which the blade is designed, the airscrew is not normal, and the torque coefficient curves as drawn are not strictly applicable.

It is found in practice, however, that the error introduced by assuming these curves to be applicable is not serious, and the air performance of the variable pitch airscrew agrees very closely with estimates based on this assumption. We will use, therefore, the standard curves given in Fig. 2 to calculate the advantage given on climb by the variable pitch airscrew over the fixed pitch fixed gear airscrew with engine B, both at supercharged height and at ground level.

The blades of both types of airscrew having been designed to give maximum efficiency at top speed and maximum r.p.m. at the supercharged height, the thrust horsepower at this condition will not vary.

At normal r.p.m., which can be maintained with the variable pitch airscrew over the whole speed range possible with the available power, the value of K_Q remains constant. Since V_{cl}, n and D are known, we know both K_Q and $(V/nD)_{cl}$, and only have to find the value of P/D, which gives the fixed value of K_Q at the known value of $(V/nD)_{cl}$. This is done by interpolation in Fig. 2. The maximum efficiency at the value of P/D is found from Fig. 5, and the value of V/nD at which it occurs from Fig. 1. The value of η is multiplied by $1 - s$ to find the maximum propulsive efficiency, and this in turn is multiplied by the appropriate value obtained from Fig. 6 to give the propulsive efficiency at $(V/nD)_{cl}$.

Adopting this procedure in the case of engine B we obtain the following results:—

Gear ratio	0·5/1		1/1	
Altitude	0	10,000 ft.	0	10,000 ft.
K_{Q_N}	0·01116	0·01584	0·0079	0·0112
$\frac{V}{nD_{cl}}$	0·74	0·86	0·524	0·609
$\frac{P}{D}$	1·145	1·4	0·885	1·085
$\frac{V}{nD}$ at η_{max} ...	0·84	1·085	0·62	0·79
$\eta_M(1 - s)$ ...	0·778	0·802	0·7	0·735
$\eta_{cl}(1 - s)$ ...	0·761	0·75	0·676	0·686
$H.P._T$	334	345	297	315
Fixed pitch $H.P._T$ ...	265	318	230	296
Gain	69	27	67	19

Taking the extra weight of the variable pitch airscrew into account, the gain in rate of climb with this engine at supercharged height is not very great, though appreciable. At ground level, however, the gain is considerable, the effect of the variable pitch being to give a nearly constant rate of climb from ground level to the supercharged height.

An advantage not to be overlooked is that, with the variable pitch airscrew, it is possible to develop maximum r.p.m. at all speeds in case of emergency, such as, for instance, a limited available run for take off. Actual measurements made with a machine of the single-seater fighter class fitted with an engine similar to that which we have been considering showed that the length of run required to take off with a fixed pitch airscrew could be reduced by over 30 per cent. by the use of a variable pitch airscrew.

It has been said already that the slope of the power

curve of the engine which we have considered in detail is normal. If the power curve were abnormally steep the variable pitch airscrew would show to still greater advantage as the holding down effect of a fixed pitch airscrew at climbing speed would become more pronounced. Similarly, if the supercharged height is increased the holding down effect of the fixed pitch airscrew at ground level still further enhances the value of the variable pitch airscrew.

Where the range in r.p.m. is considerable, as in the case of engine C, in which 20 per cent. over-revving is permissible, the variable pitch airscrew makes it possible to use the full available power, whereas, as we saw, a fixed airscrew will necessitate throttling on climb or loss of r.p.m. and power at top speed.

In the case of tandem airscrews the rear airscrew is working in the slipstream of the leading one, so that the rear airscrew has to be designed for a greater airspeed than the machine attains. The range of airspeeds for the rear airscrew is much more limited than for the front one, and is bounded approximately by the limits of 0.9 and 1.1 to 1.2 of the maximum forward speed of the machine. With such a limited speed range the rear screw, if designed to give maximum r.p.m. at top speed, will not hold down to normal r.p.m. on climb, and throttling will be necessary. This causes a very rapid drop in thrust horsepower, since, under constant conditions of loading, the horsepower varies as the cube of the r.p.m. Here, again, the variable pitch airscrew is of great value, as it eliminates this source of loss of power.

It appears from our investigation that, with a fixed pitch airscrew, a low gear ratio will lead to a loss of r.p.m. and, therefore, of b.h.p., but that the increase in propulsive efficiency of the airscrew will more than counterbalance this loss and lead to improved performance. This would seem to supply the answer to the question so often asked as to what is the best gear ratio, namely, that which will give the biggest permissible airscrew diameter. Since the variable pitch airscrew gets over the trouble of holding down, the same applies even more strongly to its case.

ENGINE MOUNTING STRESSES

By R. RODGER.

By way of an introduction to the following article, we do not think we could do better than quote from the covering letter from Mr. Rodger: "I read with interest the article in THE AIRCRAFT ENGINEER *dated August 28, 1931, on 'Forces on the Engine Mounting of a Spinning Aircraft,' by Mr. D. Williams, B.Sc., A.M.I.Mech.E. I was particularly pleased to see the engine mounting receiving some attention in the technical press, as the unit is generally passed over in a rather casual manner in most treatises on aircraft structures. While admitting that the actual principles involved in stressing are not very 'highbrow,' I do think that the subject embodies sufficient tricky points, particularly as regards the allocation of the external forces, to warrant more detailed treatment. I have set myself the task of producing a* précis *on the subject, including all the vital points in a manner which, I hope, will lend itself to ready reference."*

1. Introduction

THE severely practical engineer, whose academic knowledge may be limited, is almost invariably confronted by two major difficulties. The first is the absence of a comprehensive statement, for, though the literature on a particular subject may be voluminous, it is usually scattered amongst numerous sources. The second is that even when the information sought has been found its presentation is often such as to be of little immediate practical value without additional simplification.

This state of affairs is notorious in aircraft literature and is probably due to the comparative youth of the science. So far as the writer is aware from a careful examination of British and American text-books treating of aircraft structures, the question of engine mounting stresses appears to have been dealt with most casually, and a concise and comprehensive statement on the subject appears to be desirable. The object of this paper is to supply the apparent need by collating and presenting in an immediately useful form the information on the subject contained in the various text-books referred to above.

2. Types of Mounting

After passing through various phases of development aero engines seem to have settled down into two well-defined classes of cylinder layout, viz.:—

(i) Those in which the cylinders are arranged in banks *along* the crankshaft.
(ii) Those in which the cylinders are arranged radially *around* the crankshaft.

In modern practice the majority of the mountings to accommodate the above types of engines are space frames in steel tubing, although other variations do arise, *e.g.*, bulkhead and plate mountings. However, the object of this paper is to examine the general routine methods adopted to estimate the strength of the engine mounting structure, and nothing will, therefore, be gained by going into detail variations in mounting layout.

Consequently in what follows a specific example of a space frame mounting for each of the two classes of engines defined above will be considered, and the external and internal forces affecting same will be established.

3. Properties of a Space Frame

Throughout the paper it is assumed

(i) That the point of intersection of two or more members of the frame is a pin-joint and perfectly frictionless.
(ii) That all the members are capable of withstanding either tension or compression, *i.e.*, they are all tie-struts.
(iii) That each member is incapable of being perceptibly deformed under the action of the load it may have to carry.

4. Cases to be Considered

An aeroplane is capable of three-dimensional motion and the various attitudes which it may assume are, therefore, almost indefinitely numerous. It would be an impossible task to carry out stress analysis for all the possible attitudes and it consequently becomes necessary to confine one's attention to a reasonable number of well-defined cases which past experience leads one to believe are representative of the most severe conditions normally likely to be encountered. These cases are specified by the Airworthiness Department of the Air Ministry in A.P. 970. They are as follow:—

Case I.—Turning in flight, with the engine on, at stalling attitude.
Case II.—Normal flight and landing, with the engine off, at stalling attitude.
Case III.—Static thrust and torque with the aircraft at rest on the ground, tail down.
Case IV.—Inverted flight, with the engine off, at *inverted* stalling attitude.
Case V.—Side load, with the engine off, at vertical bank attitude.

Generally it is sufficient to consider Cases I to III, inclusive, although it may sometimes be necessary to consider also Case V. Case IV need only be considered on aerobatic civil aircraft, and when called for in the specification for Service aircraft.

5. The Loads

The common varieties of loads—live and dead—are met with, the former here being those due to the tractive effort at the airscrew. The dead loads always include the weights of the engine and the airscrew, but in specific designs the weight of oil and tanks, water and radiator, pipe lines, power plant accessories, starting gear, etc., may be additive to these. If the engine has a wet sump the weight of oil therein should be considered, and likewise the weight of water in the jackets and pipe lines of a water-cooled job.

The loads to be considered in conjunction with the Cases stated above are:—

Case I. (i) Gravity forces.
(ii) Dynamic thrust and torque.
(iii) Gyroscopic couple.
Case II. Gravity forces.
Case III. (i) Gravity forces.
(ii) Static thrust and torque.
Case IV. Gravity forces.
Case V. Gravity forces.

6. Thrust and Torque

The dynamic thrust and torque are given by the formulæ

$$T_D = \frac{\eta\, 550 \times (\text{H.P.})}{V_S\sqrt{N/2}} \quad \ldots\ldots\ldots\ldots \quad (1)$$

and

$$Q_D = \frac{33{,}000 \times (\text{H.P.})}{2\pi \times (\text{r.p.m.})} \quad \ldots\ldots\ldots\ldots \quad (2)$$

where

T_D = dynamic thrust, in lbs.
Q_D = dynamic torque, in lbs. ft.
H.P. = the brake horse-power of the engine when the aircraft is flying horizontally at speed $V_S\sqrt{N/2}$.
V_S = the aircraft velocity, in ft./sec., in normal horizontal flight with C.P. forward.
N = the load factor on the wings for C.P.F.
η = the airscrew efficiency which in the absence of specific data is assumed to be 0.8.
r.p.m. = the *airscrew* revs. per min.

In Case III the airscrew exerts maximum thrust and torque, and in the absence of more accurate data the former is taken as 5 lb./h.p. at the crankshaft at the maximum engine speed.

Static torque is given by

$$Q_s = \frac{33000 \times (\text{H.P.})_1}{2\pi \times (\text{r.p.m.})_1} \quad \ldots\ldots\ldots\ldots \quad (3)$$

where

Q_s = static torque, in lbs. ft.
$(\text{H.P.})_1$ = maximum brake horse-power of the engine at full throttle.
$(\text{r.p.m.})_1$ = airscrew speed, in revs./min., appropriate to $(\text{H.P.})_1$.

7. Gyro Couple

Gyroscopic effect is of importance in the case of engines fitted with large diameter airscrews. A gyro couple is induced under the influence of which the aircraft has a tendency to weave either nose-up or nose-down on a sharp turn. The magnitude of this couple is given by

$$C = \frac{I\Omega\psi}{g} \quad \ldots\ldots\ldots\ldots \quad (4)$$

where

C = gyro couple, in lbs. ft.
I = polar moment of inertia of the rotating parts, in lbs.-ft.^{2} This usually only refers to the airscrew.
Ω = angular velocity of the airscrew, in rads./sec.
ψ = angular turning velocity of the aircraft, in rads./sec.
g = 32.2.

Considering the individual items in formula (4), the following values for I are taken from the Royal Aeronautical Society's "Handbook of Aeronautics." Note that the I of the engine crankshaft is considered to be negligible when compared with that of the airscrew and is generally omitted from the calculations.

For timber 2-blader, $I = 0.0016\ D^5$ .... (5A).
For timber 4-blader, $I = 0.0032\ D^5$ .... (5B).
For hollow steel blades, $I = 0.014\ D^4 + 0.021\ D^3 - 21$ per blade .... (5C).
For solid dural blades, $I = 0.018\ D^{4.4}$ .... (5D).

where

D = airscrew diameter, in feet, in each case.

$$\Omega = \frac{2\pi\,(\text{r.p.m.})}{60} \quad \ldots\ldots\ldots\ldots \quad (6)$$

where

r.p.m. = *airscrew* speed, in revs./min.

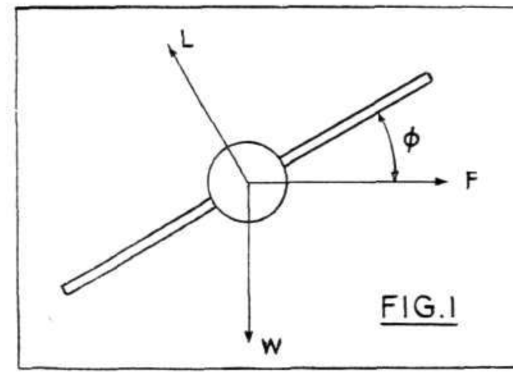


FIG. I

Fig. 1 shows an aircraft in equilibrium on a banked turn, the three forces being W, the weight; L, the lift; and F, the centrifugal force, and they are all assumed to act through the c.g. of the aircraft.

Now,

$$F = W \tan\phi$$

Also,

$$F = \frac{W\psi^2 R}{g}$$

and

$$\psi R = V_S\sqrt{N/2}$$

where

R = radius of the circle on which the aeroplane is turning, in feet.
$V_S\sqrt{N/2}$ = flight speed, in ft./sec.

Hence,

$$\frac{W\psi V_S\sqrt{N/2}}{g} = W \tan\phi$$

whence

$$\psi = \frac{g \tan\phi}{V_S\sqrt{N/2}} \quad \ldots\ldots\ldots\ldots \quad (7)$$

It is laid down in A.P. 970 that the aircraft shall be considered as banked to the angle ϕ to the horizontal, ϕ being defined by

$$\cos\phi = \frac{2}{N} \quad \ldots\ldots\ldots\ldots \quad (8)$$

where

N = C.P.F. load factor on wings.

This completes the data necessary for the calculation of the gyro couple.

8. Precession

To the lay mind it always seems to be a matter of some difficulty to grasp in precisely what manner a gyroscope will precess under defined conditions. In the writer's experience even practical engineers possessed of sound mechanical knowledge are sometimes hazy on this matter of gyroscopic precession. Their difficulties would

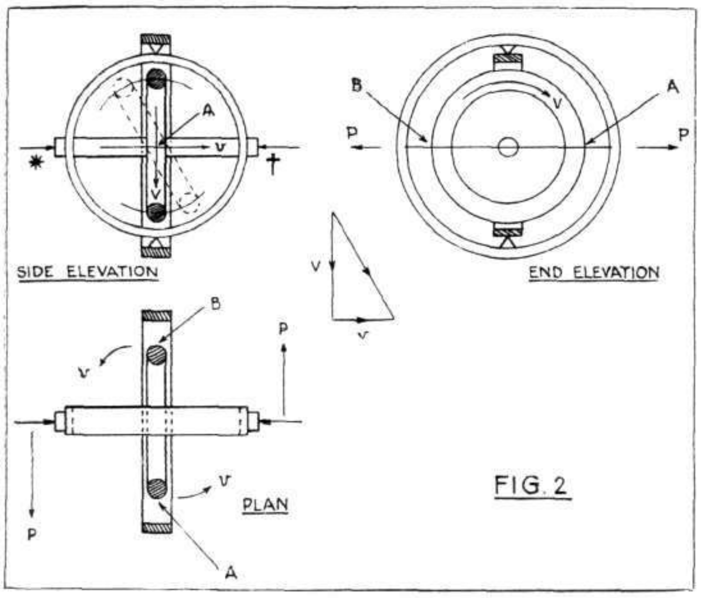
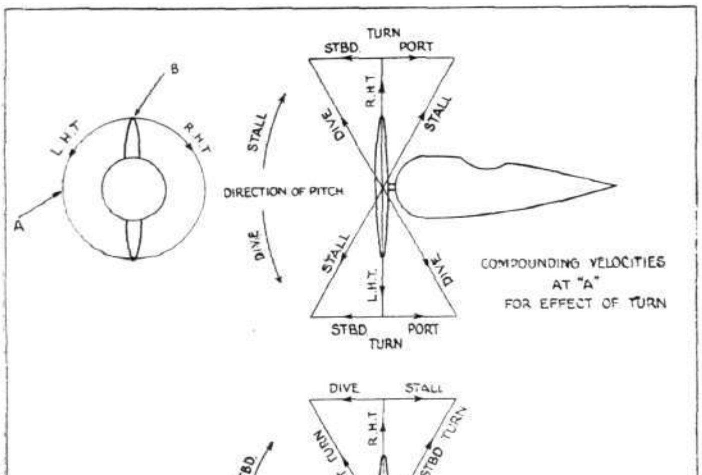


FIG. 2

appear to arise from persistence in attempting to *visualise* compound motion instead of merely applying Newton's very simple Second Law of Motion.

Consider the simple gyroscope shown in Fig. 2 wherein the wheel, rotating clockwise (end elevation), is disturbed by an anti-clockwise couple **PP** (plan). *Any point on the rim of the wheel entering or leaving the plane of the disturbing couple has instantaneous angular velocity in two rectilinear planes.*



AIRSCREW ROTATION	TURN		PITCH	
	PORT	STBD	DIVE	STALL
	PRECESSION		PRECESSION	
R.H.T.	STALL	DIVE	PORT TURN	STBD TURN
L.H.T.	DIVE	STALL	STBD TURN	PORT TURN

FIG.3.

To determine the combined effect of these two instantaneous angular velocities, and of the motion in general, apply Newton's Second Law by compounding the velocities at either of the points **A** or **B** where the rim of the wheel cuts the plane of the disturbing couple. In the diagram the triangle of velocities has been constructed for the point A (side elevation), the hypotenuse of this triangle giving at once the position to which this particular wheel will precess under the action of the couple **PP**.

In Fig. 3 this principle has been applied to an aircraft fitted with either right-hand or left-hand tractor and turning port or starboard, the direction of precession, or weave, being given in the small table as determined by compounding velocities at point **A**. In a similar manner the effect of pitch on precession is determined by compounding velocities at point **B**.

9. Components of Gyro Couple

The gyro couple has components in yaw and pitch, resisted by control forces on the rudder and elevators, respectively. The values of these components are given by

$$C_y = C \sin \phi \quad \ldots\ldots\ldots\ldots \quad (9)$$

and

$$C_p = C \cos \phi \quad \ldots\ldots\ldots\ldots \quad (10)$$

where

C_y = yaw component of gyro couple, in lbs. ft.
C_p = pitch component of gyro couple, in lbs. ft.

The results obtained with these formulæ are only approximate, but even so, they are sufficiently accurate for practical purposes as evidenced by their adoption by the Airworthiness Department.

10. The Inverted Stall

The treatment for the inverted flight case is very similar to that adopted for normal flight, and as only the "engine off" condition arises we are merely concerned with gravity loads and the stalling angle of the inverted aerofoil. In the absence of more accurate data it is usual to consider the angle of incidence corresponding to the inverted stall as $-15°$, *i.e.*, the attitude of the machine will be upside down and *nose down* to give $-15°$ incidence.

(To be continued)

TECHNICAL LITERATURE

SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS

These Reports are published by His Majesty's Stationery Office, London, and may be purchased directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through any Bookseller.

SOME WIND TUNNEL EXPERIMENTS ON THE COWLING OF AIR-COOLED ENGINES. By W. G. A. Perring, R.N.C. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1413 (Ae. 534). (49 pages and 22 diagrams.) April, 1930. Price 2s. 6d. net.

It is well known that the drag of an air-cooled engine can be much reduced by the addition of a suitable form of cowling. The present tests were therefore undertaken to investigate the cowling of an air-cooled radial engine and, in particular, to develop a suitable "helmet" cowling for this type of engine. Certain other forms of cowling have also been tested.

The experiments have been made to investigate the effect on performance resulting from the addition of various types of cowling to an aeroplane fitted with an air-cooled radial engine.

The tests have been made on a one-fifth scale model representative of a single-seater Bristol "Bulldog" fitted with a Jupiter VII engine. Measurements of the lift and drag of the model, fitted with a dummy spinner and without an airscrew, and measurements of the lift and the resultant of the thrust and drag for the model with airscrew, have been made for a number of engine and cowl combinations.

The tests have shown that the drag of an air-cooled engine can be much reduced by the addition of suitably designed cowlings.

The tests with helmet cowl, ring cowl, and polygonal Townend ring all yielded about the same improvement (a reduction of approximately 20 per cent. of the minimum drag of the whole aeroplane uncowled) when tested without airscrew, and the absolute decrease of drag coefficient was approximately independent of the incidence over the range tested, *i.e.*, from the incidence for maximum level speed to that of maximum rate of climb.

The tests with airscrew indicate a gain in level flight performance due to cowling consistent with the reduction of drag found for the tests without airscrew; an analysis of the experiments suggests that the speed at 12,000 ft. can be improved by about 10 per cent. by the addition of cowling.

Cowling reduces the cooling of the cylinder in all cases tested, and with helmet cowls it is necessary to fit an internal lining to the cowl in order to cool the cylinders adequately.

Full scale tests on a Bristol "Bulldog" will be made for comparison with the model experiments. **Arrangements are being made to test a Short helmet cowl, another N.A.C.A. cowl and two types of Townend ring.**

ADDITION OF ROLLING MOMENTS DUE TO ROLL AND SIDESLIP. By H. B. Irving, B.Sc. R. & M. No. 1418. (3 pages and 3 figures.) June, 1931. Price 4d. net.

From some preliminary tests on the effects of sideslip on the rolling and yawing moments due to rolling, it had been found that the effects of sideslip and rolling were not additive after the stall. Since these experiments were made, pressure distribution data on a yawed aerofoil have become available, which have enabled earlier data to be analysed taking into account the variation of incidence along the span due to rolling. If this is done, it is found that the discrepancy previously found is very much reduced.
The work also throws some light on the effect of dihedral angle in spinning.

SOME FEATURES OF THE EARLIER PTERODACTYL DESIGN. By S. B. Gates, M.A., and D. M. Hirst, M.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1423 (Ae. 544). (8 pages and 5 diagrams.) June 15, 1931. Price 9d. net.

It was desired to examine theoretically the bearing of certain novel features of the earlier Pterodactyl designs on the observed peculiarities of their longitudinal motion, particularly in bumpy weather.
The early Pterodactyl has a small longitudinal moment of inertia, a small damping moment in pitch, and large wing tip controllers with correspondingly large moment of inertia of the control system.
It is suggested in general terms that the combination of small inertia and aerodynamic resistance to rotation with large inertia of the control system is likely to lead to the type of trouble experienced.
Abolishing Mq has important effects on the fluctuation of acceleration after encountering a bump with control fixed. The deficiency of Mq of the Pterodactyl is, however, fully compensated in this respect by the smallness of its longitudinal moment of inertia.
The calculations of stability with controllers free suggest that the inertia of the Pterodactyl control is sufficient to bring it to the verge of instability even if the controller moments due to change in incidence and controller angle have the same relations as for an ordinary tail system. There are indications, however, that this is not so, and that the aerodynamic properties of large tip controllers may of themselves lead to instability in the hands-off condition.

PRIMARY STRESSES IN THE HULL OF A RIGID AIRSHIP. By L. Chitty, A.F.R.Ae.S. and R. V. Southwell, F.R.S., F.R.Ae.S. R. & M. No. 1427. (41 pages and 8 diagrams.) May, 1931. Price 2s. net.

The authors take a tubular framework generally representative of airship hulls as these have been designed in recent years, but simplified to meet the requirements of analysis. Longitudinal and crossed diagonal members are connected by pin joints to a series of transverse rings (or "bulkheads") so as to form a cylindrical tube which may comprise any number of exactly similar bays. The shape of the cross-section is a circle. All the longtitudinals are assumed to be similar in respect of their elastic properties, and also all the diagonals; the relative elasticity of longitudinal and diagonal members is defined by an arbitrary parameter k.
The authors concern themselves with the effects of forces applied at the joints of the tubular framework, and acting in directions parallel to the longitudinals; and to simplify the analysis of this problem a further assumption is made *that the transverse rings, or bulkheads, are completely rigid against forces tending to distort them in their own planes.* Arguments are adduced to justify the making of this assumption in an investigation which is intended to have some bearing on the problem of the rigid airship. It amounts to the assertion that each bulkhead consists of a thin but inextensible disc.
On this understanding, the cross-section of the tube will retain under all conditions its original shape, and hence the displacement of any particular joint can be completely specified by a single component w—the distance through which it moves in an axial direction, relatively to its initial (unstrained) position. Our problem is to determine w for every joint (and from this can proceed at once to calculate the stress in every longitudinal or diagonal member) when the applied forces, or displacements of particular joints, are arbitrarily specified; *in this paper the investigation is restricted to cases in which the applied forces are wholly axial.*
Within these limitations, the authors obtain a complete and exact solution of our problem. Whatever the number of bays, and without restriction on the nature of the applied forces (except that they must, of course, be self-equilibrating), they have developed a procedure which is easy to understand and apply, and which does not—like the customary methods for dealing with highly redundant frameworks—involve the solution of a group of simultaneous equations, whether by determinants or otherwise.
The principles underlying the solution are briefly as follows:—Stress distributions are shown to exist which have the characteristic that the axial displacements of corresponding joints in adjacent bulkheads, and the stresses in adjacent bays, have a constant ratio to one another: in the nature of the case, the displacements and stresses may increase either in one direction along the axis or in the other. Such stress-distributions are here termed "normal": in each the displacements vary from joint to joint of any one bulkhead in a perfectly definite way; and each requires, at a terminal bulkhead, a definite distribution of forces for the maintenance of equilibrium. If then the specified displacements or forces *at both ends of the tube* have this appropriate distribution, the stresss system produced will be made up of two "normal" components, similar in type but with amplitudes increasing in opposite directions. Combining these in suitable proportions the authors satisfy two boundary conditions—*e.g.*, one for each end of the tube.

SOME POSSIBLE CAUSES OF DISCREPANCY IN THE PERFORMANCES OF AIRCRAFT OF THE SAME TYPE. By W. G. Jennings, B.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1428. (5 pages and 3 diagrams.) August, 1931. Price 6d. net.

In view of the discrepancy that sometimes arises between the measured performances of aircraft of the same type, an investigation has been made into some of the possible causes that may contribute to this discrepancy. The following sources of error have been considered and the magnitude of their effect on the resulting performance deduced.

(*a*) Vertical currents.
(*b*) Variation of power developed by the same type engine.
(*c*) Errors due to incorrect "variation of power with height law" assumed in the reduction.
(*d*) Differences in airscrews made to the same design and the consequent variation in rate of rotation when absorbing the same torque.

It appears that (*a*), (*c*) and (*d*) may each produce a difference of about 1 per cent. in top speed and (*b*) a difference of 1·5 per cent.

CASES OF PURELY TORSIONAL LOADING ON STRIPPED AEROPLANE WINGS. By H. Roxbee Cox, Ph.D., D.I.C., B.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1436. (12 pages and 2 diagrams.) August, 1931. Price 9d. net.

It was necessary in the course of certain investigations into wing flutter to calculate the torsional stiffnesses of a number of aeroplane wings. In these investigations, the typical torsional stiffness was defined in terms of the displacement of a section of the wing near to its tip due to loading applied only in the plane of that section. A simple method of sufficient accuracy for the purpose was used in calculating the torsional stiffnesses, but prior to its adoption a method had been investigated which took account correctly of the interaction between ribs and spars in a conventional two-spar wing on the assumption that the ribs were rigid connections between the spars.
For the particular case of loading mentioned, formulæ obtained by both methods gave results sufficiently approximate to justify using the simpler method in the large number of cases dealt with. The degree of agreement between the two methods is, however, dependent on the distributions of elasticity and applied torque, and in certain examples the more complicated procedure seems unavoidable.
The cases of a cantilever wing and of a wing—such as that of a "semi-cantilever" monoplane or single-bay biplane—with one set of external supports are dealt with. For the case of torque applied at the wing-tip, approximate formulæ are obtained which correspond to a procedure sometimes convenient in the calculation of the torsional stiffness of an actual wing: the degree of approximation to be expected when using these formulæ is demonstrated. The practical application of the methods given to actual wings is the subject of further work now in hand.

WIND TUNNEL EXPERIMENTS ON HIGH TIP SPEED AIRSCREWS. By A. S. Hartshorn, B.Sc., and G. P. Douglas, D.Sc. R. & M. No. 1438. (12 pages and 8 figures.) July 1, 1931. Price 9d. net.

The work described in this report is a continuation of the general investigation of the properties of high tip speed airscrews which has been in progress for some time at the Royal Aircraft Establishment. Previous reports on this subject have been, R. & M. 1086, 1091, 1123, 1124, 1134, 1174, and 1198. In the last-mentioned paper, torque grading measurements were made on 2 ft. diameter steel airscrews with the following blade sections: thin conventional, 0·082 c. thick, and low camber Joukowski, 0·10 c. thick (R.A.F. 28). The present report gives the results of similar measurements for a still thinner conventional section, 0·06 c. thick. Lift and drag coefficients have been determined from slipstream analysis and drag measurements of the thrust have been made on airscrews. It is found that the lift values of the thin section are maintained to a higher speed than those of any of the thicker sections previously tested. For this airscrew a fairly well-defined flutter region was found in which running was not possible.

SUMMARIES OF N.A.C.A. TECHNICAL REPORTS

The National Advisory Committee for Aeronautics is the American equivalent of our Aeronautical Research Committee, with headquarters at Washington, D.C. The Technical Reports issued by the N.A.C.A. are obtainable from the Superintendent of Documents, Washington, D.C., U.S.A. In the summaries printed below the prices of Reports are given. These prices are net, and a small amount should be added to cover postage. For the guidance of potential purchasers it may be pointed out that the Reports rarely exceed 5 oz. in weight.

NO. 385. WIND TUNNEL TESTS ON AIRFOIL BOUNDARY LAYER CONTROL USING A BACKWARD-OPENING SLOT. By Millard J. Bamber. Price 20 cents.

This report presents the results of an investigation to determine the effect of boundary layer control on the lift and drag of an airfoil. Boundary layer control was accomplished by means of a backward-opening slot in the upper surface of a hollow airfoil. Air was caused to flow through this slot by a pressure which was maintained inside the airfoil by a blower. Various slot locations, slot openings, and wing pressures were used. The tests were conducted in the 5-ft. atmospheric wind tunnel of the Langley Memorial Aeronautical Laboratory.
The quantity of air flowing through the slot per unit of time was measured and is presented in coefficient form. A coefficient is derived from which the power required to maintain the air flow through the slot may be computed.
The effect of each variable is illustrated by characteristic curves. A discussion indicating the advantages which might be possible by the application of the boundary layer control to an airplane is included.
A discussion of the various forces produced on the airfoil by this type of boundary layer control and their resultants is given in Appendix I.
Under the test conditions, the maximum lift coefficient was increased about 96 per cent. for one slot arrangement, and the minimum drag coefficient was decreased about 27 per cent. for another, both being compared with the results obtained with the unslotted airfoil. It is believed from the results of this investigation that the above effects may be increased by the use of larger slot openings, better slot locations, multiple slots, improved airfoil profiles, and trailing edge flaps.

Airport Development

A paper read before the R.Ae.S. on April 21 by Mr. N. Norman after he had, with Mr. Graham Dawbarn, toured the U.S.A. in a Puss Moth, visiting many airports in 6,600 miles flying at an average ground speed of 108·5 m.p.h. (Paper Abridged—Ed.).

FIRST let me say that I hope that it will in time become plain that although both architects and civil engineers should be employed from the first, in connection with the development of an airport, it is essential for the proper co-ordination of their different skills, and to preserve close co-operation between them and the users of the aerodrome, that the principal engineer be a man whose studies have been devoted solely to the object in view, and whom I should prefer to describe as an "air planner."

I am chiefly concerned with the development of the aerodrome site when selected. I must apologise that most of the illustrations have come from the United States, but I was recently able to examine a number of airports in company with Mr. Graham Dawbarn, in that country.

Airport development is controlled by three factors—the nature of the traffic to be dealt with, its volume, and the geographical and meteorological conditions which prevail at the site. Aerodrome traffic is still insignificant, but in America has perhaps reached larger figures than over here. At the major ports movements of scheduled traffic average from 95 to 60 per day.

As the majority of airport planning is done within the boundaries of the airport site, it is logical to begin with that part used for landing. The minimum dimensions required for a licence for all types are slightly smaller in England than in America, where an effective landing run of at least 2,500 ft. is required in eight directions. Where the landing area is laid out as runways, these are required to be 500 ft. wide for a first-class rating, and experience has shown that where a single runway is to be used for landing and taking off, 400 ft. is the minimum satisfactory dimension, but these may have to be increased in the future if the type of aircraft used alters to any extent.

We in this country are using larger aircraft than the Americans, and one can easily picture three or four "Hannibals" tending rather to jostle one another on a 400 ft. wide strip. The length of the landing area must also be varied where the airport is at any considerable altitude. Some examples of the extent to which it must be increased may be interesting. Taking an accepted calculation; for an altitude of 2,000 ft. the length should be increased 10 per cent., for 4,000 ft. 25 per cent., 6,000 ft. 50 per cent., 7,500 ft. 75 per cent., and 100 per cent.

Mr. Nigel Norman leaves Mr. Fred Denslow, manager of the United Airport at Burbank, to face the camera alone. The "Puss Moth" was borrowed from the de Havilland works at Toronto.

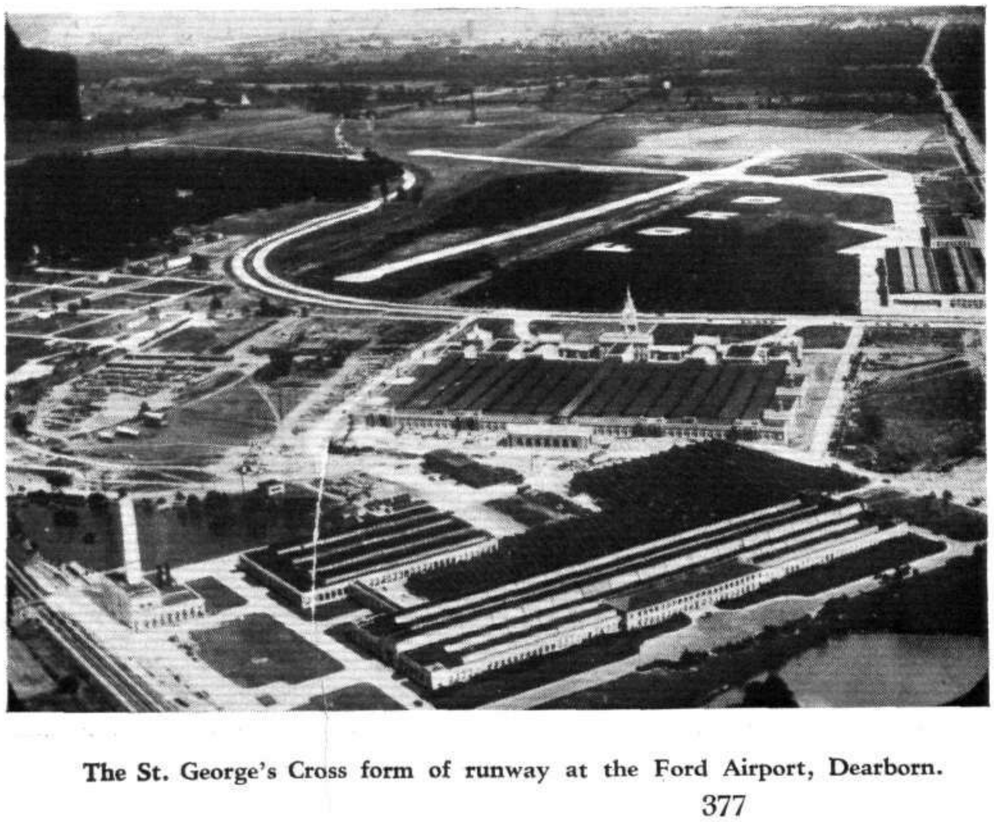
for 8,500 ft. This factor applies seriously on a number of Empire air routes.

It would seem that in planning a major airport, a considerably larger area is desirable than has usually been possible in this country. The Americans, more fortunately placed than we in this respect, have taken due regard of this point. Chicago, while using 160 acres, has reserved 640 acres. Kansas City has available 800 acres. Oakland has reserved 850 acres, while Indianapolis has allocated 947 acres. This generous planning will react to the advantage of the cities in question, since not only the airport itself but all its surroundings will be developed as a concrete whole.

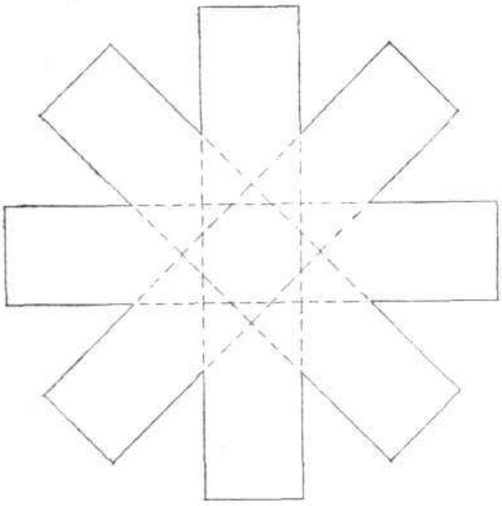
In Europe our aerodromes, surfaced with turf and available for landing in every direction, are the envy of the Americans whose soil and weather conditions compel them to prepare specially surfaced strips as runways. There appears to be some doubt as to the value of the two systems. At Cleveland, an "all way" field, I was told that it was only owing to this characteristic that the tremendous traffic, amounting to as much as 950 movements in a day at the time of the National Air Races, could be handled. On the other hand, at Detroit, where a purely runway aerodrome has been developed, it was explained that at the time of the annual Exposition, it was only by the systematic use of runways that it was possible to handle traffic averaging 200 movements hourly for seven consecutive hours, and reaching 256 movements in the most crowded hour.

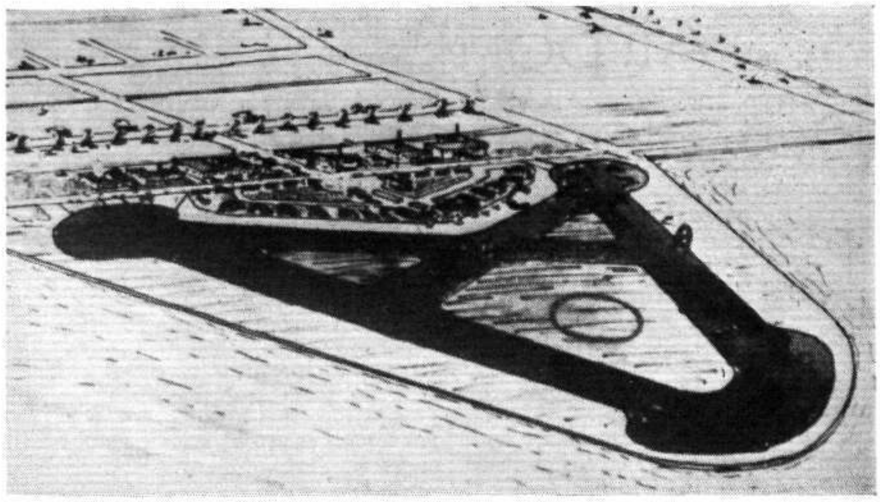
[It is interesting to note that the peak traffic at Waterloo Station, London, only reaches 90 movements per hour or 240 movements during the three best hours, which are from 7 a.m. to 10 a.m. —Ed.]

The materials in use for runway construction are numerous. We were able to examine runways made of concrete, of so-called asphaltic-concrete, of waterbound Macadam and of Macadam with Colas penetration, and also some made by compounding the surface soil with a spray of asphaltic oil. In some cases, 3 ft. of ordinary cinders were used, while on emergency landing grounds in the desert areas of Arizona and New Mexico the runways were some-



The St. George's Cross form of runway at the Ford Airport, Dearborn.



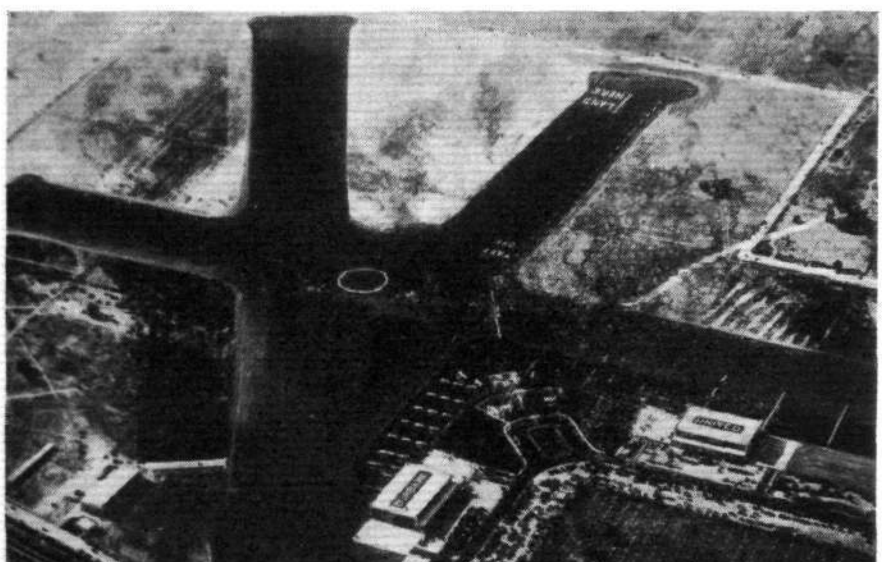


Runway design can be uneconomical, as in Figure 1 on the left at Albuquerque, or economical, as in Figure 2 on the right at New Orleans. The area of this latter is only 9/10ths of the former, while giving equal landing facilities.

times merely of levelled and rolled sand. In sandy areas, where little rainfall is expected and drainage is simple, oil sprayed runways appeared extremely effective. On clay subsoil, concrete would appear to be the best solution. Where asphalt or Macadam are used, a foundation of hard core or broken rock is necessary. Cinders appear to be the least satisfactory solution, requiring constant maintenance and being subject to a process of deterioration known as "rot," which gradually reduces them to powder. At one aerodrome, cinders treated with asphaltic oil were used, producing a satisfactory surface, but still apparently requiring a good deal of maintenance.

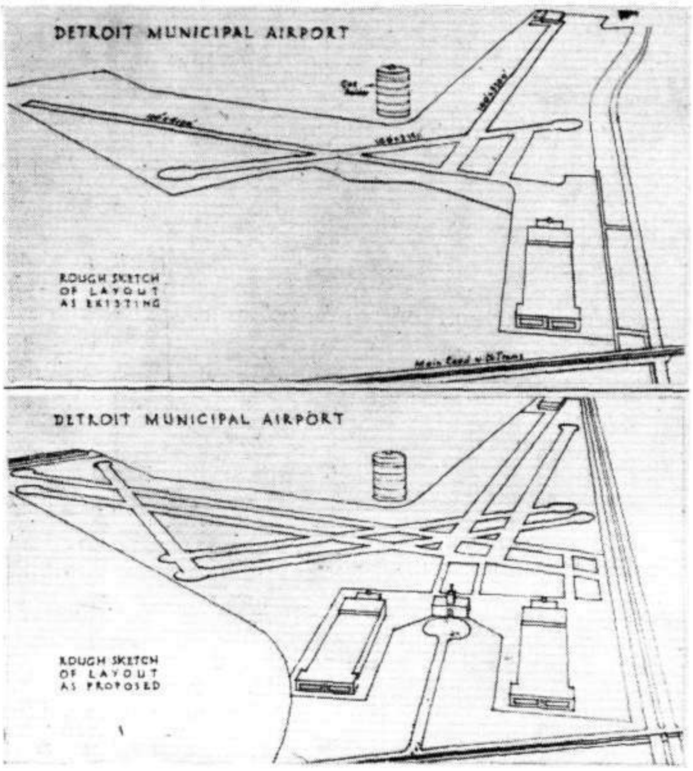
The pattern in which runways are laid down does not appear to have been seriously considered at the earlier airports. If eight directions of landing were required, you had a Union Jack, if only two intersecting runways were allowed for you might support St. George or St. Andrew. In more recent layouts, however, it is evident that the pattern has been carefully studied, and it has been found that a proper arrangement will allow considerable economy in the amount of material required, and at the same time make for greater convenience in operation. A theoretical example may be of interest. Fig. 1 shows diagramatically four runways, 2,500 ft. long by 500 ft. wide at 45 deg. interval arranged as a symmetrical star. Fig. 2 shows the same runways at the same angular interval arranged in a different pattern, which allows for more convenient spacing of the buildings. The control tower and terminal building would obviously be based in the centre towards the top of the figure, while commercial and industrial buildings could be arranged along the sides without interfering with any of the flightways. In addition to allowing a more satisfactory complete layout, reducing taxying and facilitating control, the area of this figure is only 9/10ths of that of the star. A modification of this design has been employed at Kansas City, and the newly-designed Shushan airport, New Orleans, while the new municipal airport at Pittsburg employs a somewhat similar arrangement. The runway pattern will be subject to variation where meteorological conditions allow the elimination of a number of directions of landing. At Burbank one runway has never been constructed, while at Glendale, only a few miles away, only one strip is ever used at all. The new Pittsburg airport illustrates the logical development of a runway aerodrome, as strips have been so widened as to cover practically the whole surface of the port. Each, however, is divided by a clearly marked line, which is intended to separate the landing from the taking-off area.

Reference must be made to an exceedingly important problem—that of drainage. In this country where turf aerodromes are in use and where rainfall is moderate and evenly distributed, the problem is not a difficult one, although the standard required is much higher than that demanded for agricultural purposes. When the levels of an airport have been carefully plotted, it is a simple matter to locate the main surface drains into which the water may be led by means of mole drains, agricultural open pipe drains or clinker filled trenches. It is to be noted that an absolutely flat area is the most difficult to deal with, and that gradual falls, which have no adverse effect in the movements of aircraft, may be used with valuable effect to assist in the disposal of surface water.

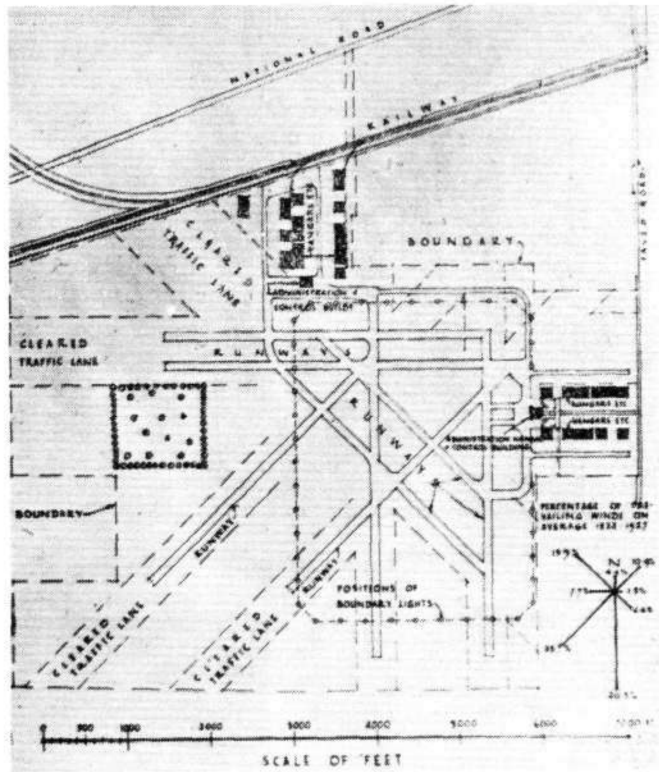


At Burbank, one runway has been omitted, as the wind never causes landings to be made in that direction.

Where runways are concerned, the drainage problem becomes more complicated. The runways being non-absorbent, to avoid standing water they must be constructed with a crown three or four inches in height per 100 ft. of width. The runway itself forms a considerable catchment area, and, unless specially dealt with, water running from it will produce a sodden condition of the ground at each side, so that special drainage must be provided to take care of this point. The problem is somewhat the same where the concrete or asphalt apron in front of the building meets the aerodrome. Various suggestions have been made for the construction of a porous strip at each side of a hard surfaced runway to allow the water to percolate through into a drain below, but these strips being made of loose material, which is easily disturbed by passing traffic, are a constant nuisance, and it seems likely that the more satisfactory arrangement will be for the runway to be constructed to provide its own drainage channels and outlets. As an example of the extent to which drainage may figure in the construction of an



Detroit as it is, and as it will be when the double runways are made.



Proposed Development at the Indianapolis Municipal Airport.

all-way landing field, the airport at Cleveland may be quoted. Here over a million feet of agricultural drains spaced 20 ft. apart were used. 15 miles of 15 in. sewer at 40 ft. spacing were laid and over $3\frac{3}{4}$ miles of 4 ft. sewer were put down to carry storm water into a neighbouring ravine.

The disposition of the buildings round the airport must be largely controlled by the plan of the flightways or runways. This again is a problem which was imperfectly understood when many Americans airports were constructed.

Apart from the rectangular, two types of arrangement appear to be emerging into favour—first, and very much the most popular, the arrangement of buildings in a more or less " V " intruding upon the landing area and having the terminal or station building at its apex. The other allows for the buildings to be arranged in one or more rows stretching directly away from the landing ground. Examples of the blunt " V " are United Airport, Burbank; San Francisco Bay, California; Shushan Airport, New Orleans; already referred to, and Pittsburg Municipal Airport. A particularly striking example of the second arrangement is at Detroit, which at present uses one tremendous hangar of 200,000 sq. ft. area. The same tendency is illustrated at Indianapolis. It is obvious that as traffic develops, the demand for hangar and administrative accommodation will absorb the whole perimeter of the airport, and that a number of smaller though possibly less important blocks will ultimately be developed.

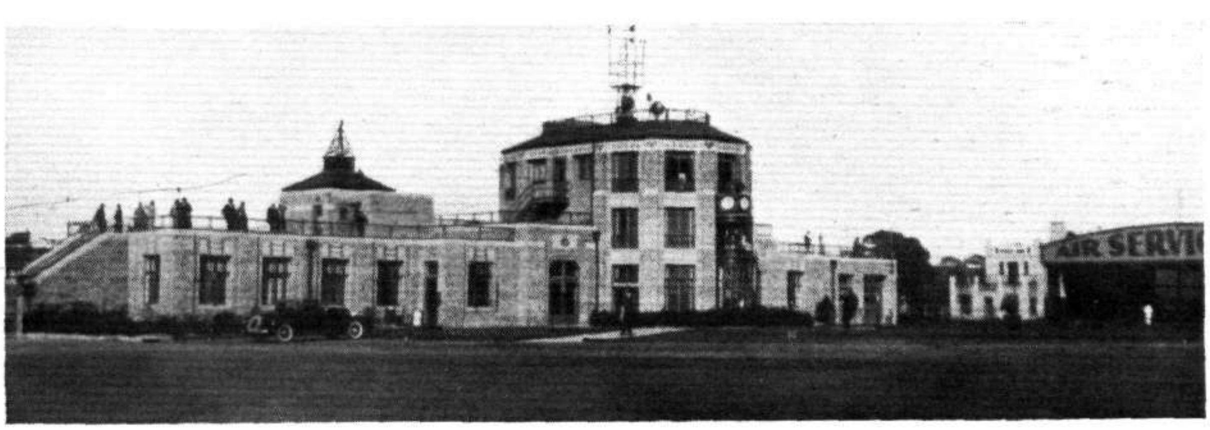
At the Tempelhof Aerodrome in Berlin, where, although the rectangular arrangement has been followed, an area in front of the main building has been restricted from use for landing. The effect of the arrangement seems to have been to sterilise this piece of ground for all purposes except unnecessary taxying. Generally speaking, one may conclude a more or less circular design with buildings along a circumference will provide the shortest landing runs, the least amount of building area, and will occupy the greatest superficial area. By so far as it departs from this, the plan should become more economical and more convenient until such time as the gradual intrusion of the buildings reduces the breadth of the flightways to an extent which unduly limits the volume of traffic which can be handled.

If we reject the "rectangular" type of plan, in which all buildings are equally distant from the landing area, we shall find that the arrangement will always offer one or more sites most accessible to air traffic and dominating the area to be used for landing. This site will be at the inner end of a block of building development. One site usually occupies the most important position of all, and this obviously should be reserved for the terminal building and chief airport station. Such a terminal building will house traffic control and airport administration, and no doubt provide passenger facilities for the more important air traffic.

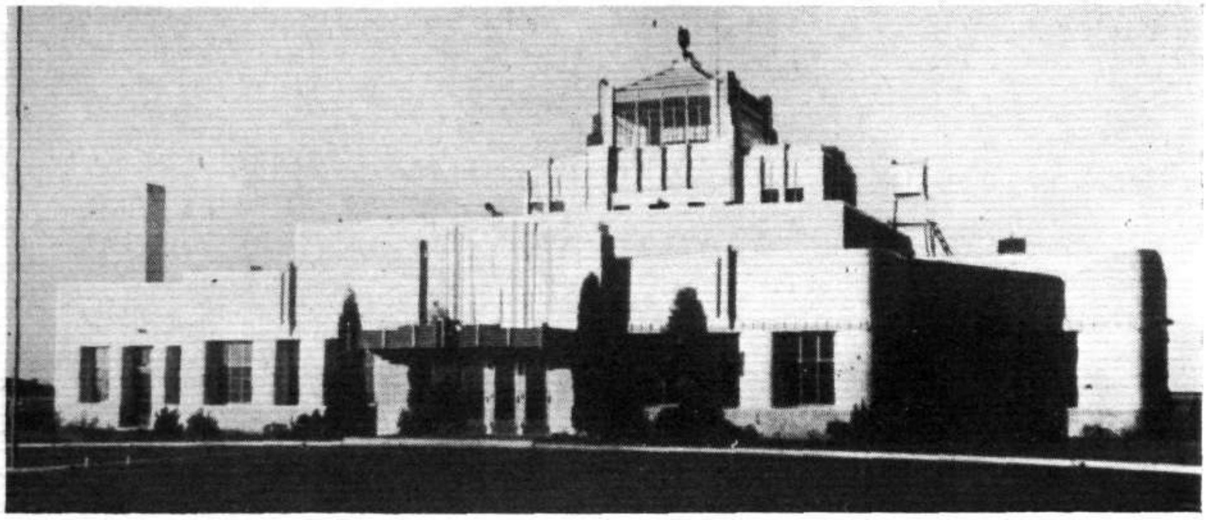
In terminal buildings it has been found necessary to provide accommodation divided broadly into three classes:

(1) Administrative accommodation.

(2) Passenger accommodation.



The main station building at Buffalo.

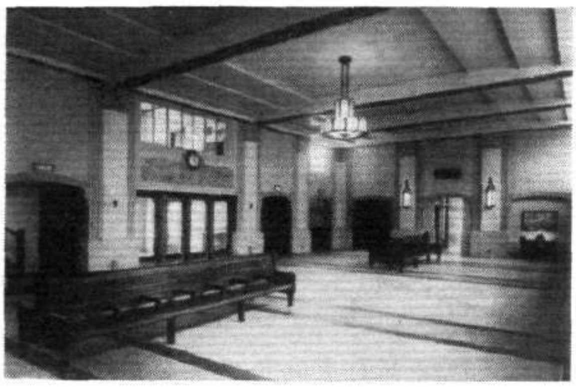


Tulsa ; another fine-looking airport building of architectural merit.

(3) Accommodation for sight-seeing public, whose presence as spectators is only valuable for propaganda purposes and in so far as a small revenue is derived from their entertainment.

At the present time the volume of air traffic handled at important airports has been so small that the importance of the sight-seer has occupied an exaggerated position in the plan.

But as air travel becomes more popular and the spectacle of its operation more commonplace, the sight-seer will diminish in importance, and it seems probable that the plan originally adopted at Croydon of catering for the outside public in an entirely separate building, may offer the final solution. Details of design are particularly a matter for the attention of the aerodrome architect, and, in fact, are his greatest opportunity.



The Tulsa waiting-room.

The control tower, houses as it were, the eyes and brain of the airport. With radio telephony becoming more and more essential to aircraft operation and with the increase of night air traffic, the tower must be laid out to bring into convenient juxtaposition wireless, telephone, and probably public address apparatus and controls for lighting and signalling equipment. It is desirable for the meteorological office to be in close proximity. In America, where the teletype is such an important part of the weather reporting system, a separate room, housing up to eight or ten of these instruments, is required at major airports.

Where passenger accommodation is concerned, on the other hand, I believe there are considerable developments to come. Originally air liners arrived singly and at long and irregular intervals. The passenger was happy to begin his air adventure by half-an-hour's wait out of doors, until the blast of a propeller and showers of mud or dust heralded the approach of the monster that was to carry him into the unknown. Aircraft unprovided with brakes and difficult to manœuvre would stop sometimes in one position and sometimes in another. As air traffic became more highly organised, however, a more regular and orderly procedure became necessary, and today at airports such as Croydon the excellent organisation and the courtesy and efficiency of the officials conceals the shortcomings of the building designed some years ago.

In America the same inadequacy was noticeable at a number of the older stations. Inclement weather conditions made it desirable to offer some protection to the passengers, and the Americans therefore began to erect canvas covered canopies of the kind so frequently seen outside the doors of hotels and residences in New York. In order to allow these canopies to reach right up to the fuselage of the aircraft after it had taxied into position, it was found convenient to mount the outer sections of the canopy on wheels or rollers, so that they might be extended in a telescopic manner. The result achieved seems very satisfactory, for by means of these extensible loading canopies, passengers are able to proceed from the station building right into the cabin of the aircraft without being for a moment exposed to wind or rain.

This is the first stage of evolution. The second stage began when it was found that several aeroplanes had at times to be loaded simultaneously.

(To be continued.)

In California Spanish architecture is the accepted practice, as here at Glendale.

AIRISMS FROM THE FOUR WINDS

A Comper "Swift" Traveller

ON April 21 Mr. M. Lacayo—a member of the Lancashire Aero Club, with some 600 hrs.' flying to his credit—set out from Heston in a Comper "Swift" monoplane (Pobjoy "R" engine) on a two months' tour of Europe. We understand the object of this tour is to demonstrate the excellent qualities of the Comper "Swift" monoplane and the Pobjoy engine en route. His itinerary includes: Brussels, Antwerp, Rotterdam, Amsterdam, Bremen, Hamburg, Travemunde, Copenhagen, Gothenberg, Oslo, Berlin, Stettin, Danzig, Konigsberg, Riga, Reval, Warsaw, Cracow, Brno, Vienna, Budapest, Belgrade, Zagreb, Prague, Strasburg, Basle, Dijon and Paris. Mr. Lacayo is using Shell Spirit and Aero Shell Oil.

A COMPER "SWIFT" TRAVELLER : Mr. M. Lacayo in the Comper "Swift" (Pobjoy "R" engine) in which he set out from Heston on April 21 on a two months' tour of the Continent to demonstrate the qualities of machine and engine.

King Albert's Flying Tour

H.M. THE KING OF THE BELGIANS is a hardened air traveller. He has recently added to his experiences by making a high-speed tour of some of the Belgian territories in the Congo. He was away from Belgium for 32 days, and was able to spend 17 of them in his African possessions. He spent 14 days in the air, and covered some 7,500 miles. His Majesty left Brussels on March 23 and travelled to Brindisi. There he embarked, as an ordinary passenger, on a "Kent" flying-boat of Imperial Airways, and flew by the regular airway to Khartum. There he was taken in a Royal Air Force Fairey III.F on a tour between Khartum and Lake Albert. On the return journey, Imperial Airways sent a special machine with Mr. G. Olley as pilot, to fly the King from Khartum to Aswan in one flight. On the return crossing of the Mediterranean, the "Kent" met a strong head wind which would have so delayed it that the petrol would have been exhausted before Crete was reached. The pilot therefore turned back to Alexandria, and King Albert was much impressed by the general caution of the Imperial Airways pilots, of which this was one example. He was loud in his praises of the comfort of the British machines and of the general organisation of the air service. He reached Brussels again on April 25.

H.E. the Viceroy Flies to Quetta

HIS EXCELLENCY LORD WILLINGDON has lately been touring the North West Frontier, and on April 23 he flew from Parachinar to Quetta, the capital of Baluchistan, where he installed the young Khan of Kalat on the *gadi* (throne) and invested him with ruling powers. Whether the flight was made in the special Viceregal Avro 10 or in a R.A.F. machine is not yet certain. The flight started early in the morning, and a landing for breakfast was made at Fort Sandeman. Quetta was reached shortly before 1 p.m. By using an aeroplane, the Viceroy was spared 48 hours of dusty travel in a train in very hot weather.

A Visit to Persia

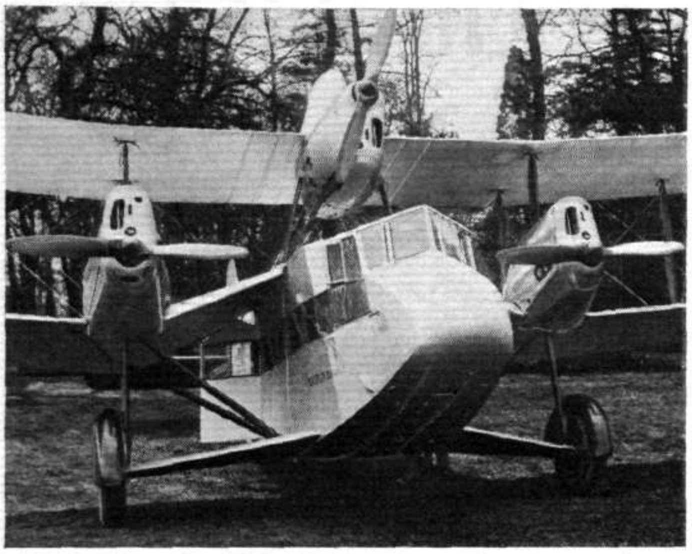
THE High Commissioner for Iraq, Sir Francis Humphrys, who was once rescued by aeroplane in dramatic fashion from the Residency at Kabul, has lately been paying a State visit to Persia. He was accompanied by some "Victoria" troop-carriers of No. 70 (Bomber Transport) Squadron and some "Wapitis" of No. 55 (Bomber) Squadron, and at the end of the visit these British machines gave a display at the military aerodrome outside Teheran. This was attended by the Minister for Foreign Affairs, the Minister for War, and the Chief of the Persian Staff. Persia has a flying corps equipped with Junkers machines, and at the end of the display some of the Persian pilots were taken up in the British machines and allowed to fly them. They are reported to have formed a very favourable opinion of the British aircraft.

The First Lord on a Carrier

DURING the last few days Sir Bolton Eyres-Monsell, First Lord of the Admiralty, visited the Fleet at Portsmouth, and spent part of his time on board the aircraft carrier *Courageous*, the flagship of Rear-Admiral R. G. H. Henderson, the Rear-Admiral of Aircraft Carriers. On Monday, April 25, he made a flight off the deck of the carrier in a Fairey III.F piloted by Lt. Com. R. St. A.

BY AUTOGIRO TO THE CAPE : The Cierva Autogiro C.19 Mark IV (100 h.p. Armstrong Siddeley "Genet"), in which Mr. J. N. Young set out from Hanworth on April 25, on a flight to the Cape. He landed at Beauval, near Amiens, for fuel, and proceeded to Abbeville next day

(FLIGHT *Photo.*)



" YOUTH OF BRITAIN II " : The first Airspeed " Ferry " poses for its portrait at Hanworth. This machine, which was described in " Flight " of April 15, is a ten-seater to be used by Sir Alan Cobham on his tour of Great Britain. The engines are two Gipsy II's and one Gipsy III. (Flight *Photo.*)

Malleson. For the rest of the day he watched the fleet fighters, torpedo-bombers, and spotter reconnaissance flights of the *Courageous* and *Furious* carrying out their normal duties. On return to H.M.S. *Nelson*, flagship of the Home Fleet, the First Lord made the following signal:—

" First Lord to Commander-in-Chief, Home Fleet. I shall be very grateful if you will inform Rear-Admiral Henderson how interested I have been in all that I have seen in H.M.S. *Courageous* and how much I have enjoyed my visit. The Board of Admiralty appreciate the valuable work done by the aircraft carriers and also realise that all departments on board share the working for the efficiency which is obviously attained."

Denmark Orders More " Bristol " Engines

The Royal Danish Army Flying Corps have placed an order with the Bristol Aeroplane Co., Ltd., for the supply of a number of the latest " Bristol " air-cooled aero engines of Mercury type. For some years past this Air Force have been fitting " Bristol " Jupiter engines into their military aircraft, and their present order is an indication of the desire of the Danish authorities to keep the Army Flying Corps thoroughly up to date with the latest and most efficient equipment. It will be remembered that quite recently the Danish Flying Corps concluded an agreement with the Bristol Aeroplane Co., Ltd., for the manufacture under licence in Denmark of the " Bristol " Bulldog all-steel single-seater fighter.

International Air Rally—Boulogne

The International Air Rally at Boulogne will take place on June 25 and 26. Full particulars may be obtained at the Royal Aero Club, 119, Piccadilly, London, W.1.

" The Training of Pilots and Instructors "

An additional lecture to those already announced will be delivered before the Royal Aeronautical Society and Inst. of Aeronautical Engineers on May 5 by Capt. J. E. A. Baldwin, D.S.O., O.B.E., entitled " The Training of Pilots and Instructors." The lecture will be held at 6.30 p.m. at the Royal Society of Arts, 18, John Street, Adelphi, W.C.2.

Wilbur Wright Memorial Lecture

On Thursday, May 26, 1932, the 20th Wilbur Wright Memorial Lecture will be delivered by Mr. H. E. Wimperis, C.B.E., F.R.Ae.S., Director of Scientific Research, on " New Methods of Research in Aeronautics." By kind permission of the Director, Col. Sir Henry Lyons, F.R.S., the lecture will be delivered in the Science Museum, Aeronautical Section, South Kensington. Mr. Wimperis will show a film which is being specially prepared to illustrate the subject of his lecture. The lecture will be preceded by the annual Council dinner, and a reception by the President, Mr. C. R. Fairey, M.B.E., F.R.Ae.S., and followed by a conversazione. Tickets for the lecture and conversazione (including buffet), price 5s. each, may be obtained direct from the Royal Aeronautical Society. Members may bring guests, and ladies are specially invited. Non-members may apply for tickets. A distinguished company will be present and early application should be made.

G.A.P.A.N. Instructors' Certificates

The Guild Instructors' Certificate has now been formally approved by the Air Council and the official Panel of Examiners has been appointed as follows:— M. H. Findlay (Capt.), London Air Park, Hanworth; H. F. Jenkins (Flt. Lt.), Air Service Training, Ltd.; J. C. Houston (F/O.), Scottish Flying Club; A. N. Kingwill (Flt. Lt.), Northern Air Lines; T. W. Campbell (F/O.), Bristol Aeroplane Co.; A. G. Loton (F/O.), Brough Flying School; R. W. Reeve (F/O.), de Havillands School of Flying.

FLIGHT-TESTING THE NEW NAPIER ENGINE : The first of these engines (6-cylinder in line air cooled, 150 h.p.) has been built into a " Spartan " aeroplane for the purpose of extensive flying tests. The machine is likely to visit, during the test period, several British aerodromes, and readers are advised to bear in mind the registration letters G-ABST. By way of mnemonic assistance we would suggest British Summer Time. (Flight *Photo.*)

The Industry

FEMININE ENGINEERING

IN the aviation world the work of women has, in the knowledge of most of us, been associated with spectacular feats like long-distance flights, solo and otherwise. The unromantic manufacturing side of the industry, involving daily life at a work bench has not, since the war, been identified with women on a large scale.

Fabric work, doping, sewing parachute silk panels together, and making tea has mainly been their allotted share in post-war aircraft industry. But there is a noteworthy exception in the case of the group of women and girls known as Atalanta, Ltd., a small engineering company with their works at 3, Brixton Road, S.E. Here, unostentatiously, women have owned, controlled, and worked an engineering business for the output of small machined parts, used for all branches of engineering, since 1920. They formed the company as a direct result of their war-time experience. Adam has no voice in this feminine enterprise unless it be the voice of an A.I.D. inspector when aviation contracts are being completed, and even then the company has the usual authority to issue release notes.

The company's staff is 20 strong at the moment, and an interesting feature of its organisation is that every employee is a shareholder. Young girls pass through an apprenticeship at the works in the same thorough way that is applied to youths elsewhere. At the moment two girls have just completed a four-years' apprenticeship, neither having missed a day during the entire period!

It is important to stress that while thousands of girls and women are still employed in factories at work on all sorts of machines they profoundly differ in their status from the employees of Atalanta, Ltd. The latter are workshop engineers in the true sense of the word, while the former are merely machine minders, who are quite expert as long as the machines do not go wrong, and when there is a breakdown then male fitters have to come on the scene. The Atalanta girls make machined parts in entirety, working, of course, direct from blueprints, and thoroughly understanding how to set and grind their tools. To the old reactionary school that still considers the advent of women into hitherto masculine industry as a frivolous stunt it would be a profound lesson to visit the Atalanta works and observe the absolutely natural atmosphere of an ordinary engineering shop, the calm, nonchalant activity of the girls in the machine shop, all dressed in blue overalls and caps, and each putting through a job without direct supervision.

That Atalanta, Ltd., have the full confidence of the aircraft industry is not only shown in their authority to issue release notes but in the large number of aircraft manufacturers for whom they have carried out sub-contracts, which have included the Gloster Aircraft Co., Ltd., the Blackburn Aeroplane & Motor Co., Ltd., Westland Aircraft Works, Saunders-Roe, Ltd., Sir W. G. Armstrong Whitworth Aircraft, Ltd., Armstrong Siddeley Motors, Ltd., and the General Aircraft Co., Ltd.

Control-column sockets for Blackburn "Bluebirds," special pulleys and bolts, fork ends, bushes and other machined fittings have been produced for these various companies, also replacements for Imperial Airways, Ltd., and special rolling mills for steel strip for Armstrong Whitworth Aircraft, Ltd. At the moment they are, amongst other things, particularly busy on various parts for the wireless industry.

PISTON RING INFORMATION

"BRICO" is a name which everyone associates with piston rings, and in FLIGHT for November 20, 1931, we gave some details of the manufacture of these very vital parts, which, though small, probably do more than anything else to ensure the smooth output of power from, and long life of, an internal-combustion engine.

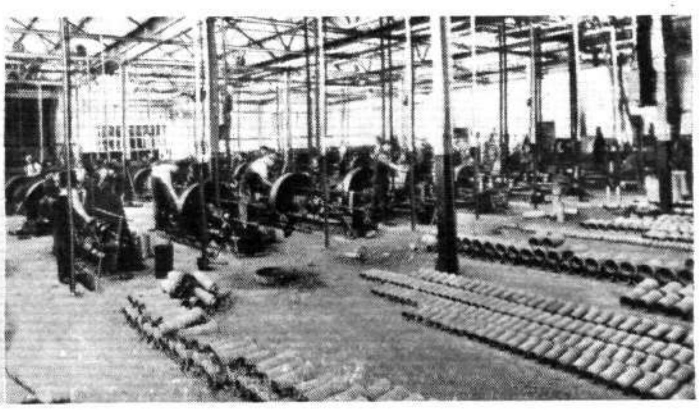
This year sees the birth of the 14th edition of the "Brico" catalogue, and a very interesting publication it is (copies will be sent by the British Piston Ring Co., Holbrook Lane, Coventry, to all inquirers who write mentioning FLIGHT).

The 19 years' experience of this firm have enabled them to evolve a range of piston ring sizes which caters for every make of engine no matter what combination of diameter and width is required. In these days everyone is economically minded, and therefore the demand for oversize rings to suit engines after they have been rebored is very large, and the supply of such rings is one of the chief cares of "Brico." This year they have added over 900 new sizes to their stock, and are thus able to provide rings suitable for any oversize to which an engine may have been bored out. The catalogue itself is interesting in that it lists almost every known make of car, motor cycle, commercial vehicle, tractor engines, marine engines and stationary engines.

Shackle bolts, valve-seat inserts, and centrifugally-cast cylinder liners are other products of this firm, and full details of all these will be found in this new catalogue.

FIRE EXTINGUISHER DISTRIBUTION

EXTINCTION of fire is always a vital matter, and a system in an aircraft which operates without the intervention of the pilot, should fire break out, must be of great importance. FLIGHT of April 1 gave some details of the "Featherspray" system which utilises "Essex" fire-extinguishers to their best advantage. It should be noted by all those interested in this system that the distribution of the apparatus is in the hands of Smiths' Aircraft Instruments, 185, Great Portland Street, London, W.1 (Welbeck 7916).

THE "BRICO" FOUNDRIES: The Sand-Casting foundry (left) and the Centrifugal foundry (right). In the latter are cast the "pots" from which piston rings are made. Centrifugal casting producing cylinders of very fine close-grained iron with a minimum of waste. Nickel-chrome alloy castings are made in the Sand foundry for pistons, valve guides and timing gear wheels, etc.

SERVICES FENCING CHAMPIONSHIP

BECAUSE fencing is now recognised as one of, if not the finest forms of training for pilots, it has in the Royal Air Force received considerable official encouragement. Their general standard, individual successes, and average of match victories have literally zoomed during the last few years, and particularly this season. Last week at Aldershot, the Royal Air Force scored one of their greatest triumphs in beating the Army 20—16, in the third and last of the annual inter-services four-weapon team matches.

Both sides had previously defeated the R.N. and R.M., and so their meeting decided the unofficial title of "Services team match champions." This is the first time since 1929 that our youngest Service has beaten both their rivals the same year, while they have not lost to both since 1926. To date they have fought the Army 14 times, winning seven and losing seven; while of 13 matches against the R.N. and R.M. they have won nine, drawn three, and lost only one. In this year's matches they beat the R.N. and R.M. at Uxbridge, 20—16, winning the foil, 7—2, the épée, 6—3, and losing the sabre, 4—5, and the bayonet, 3—6.

The Army defeated the R.N. and R.M., 19—16, scoring 5—4 in sabre, 6—3 in bayonet, drawing the épée at 4 all and a double hit, and losing the foil, 4—5.

When the victors met at Aldershot in the deciding match the odds were comparatively even, though slightly in the Army's favour by reason of their formidable bayonet record, a weapon which has for some time been the R.A.F.'s weakness.

Play opened with the foil. The Army trio of Service champions of the P.T. staff was a fearsome combination of fine, seasoned foilists who might have been backed to win by a wider margin than 5—4. The R.A.F. side was led by the British international and ex-amateur foil champion, Sqd. Ldr. Sherriff, one of the finest all-round swordsmen this country has produced, and one whose Service and inter-Service victories are quite unique. His second string was Flt. Sgt. Digby, recently returned from abroad, and the third man a fine, though variable player, Sgt. Hancock, the R.A.F. foil champion.

The foil play was superb. The R.A.F. started with their tails up, for Sherriff scored a bloodless win over Parsons in the opening fight, and Hancock secured the odd point over Wyatt, before the Army checked them by Reid's 4—3 win against Digby. Parsons then scored another last point over Hancock, and the figures were 2 all.

Digby then beat Wyatt 4—0, and Reid equalised when he secured the odd hit on Sherriff, and the event remained to be decided on the final bout. Another great fight ran level to 3 all before Reid secured the event for the Army by one point over Hancock.

Though the épée is the R.A.F.'s strongest weapon, to win this by the ample margin of 7—2 was as surprising as it was creditable.

Fighting for a single point, Stubberfield, R.A.F. épée champion and a fine all-round swordsman, was undefeated, while even the variable Bellairs was all out and only surrendered to Keen. Jarrold, a new "Blue," also contributed two wins, his loss being to the Army's title-holder, Harris, and the épée closed with the total scores 11—7 in the R.A.F.'s favour.

For sabre they fielded another fine-quality three, but the Army side was more varied in style, and consequently a slightly more difficult combination to tackle.

The redoubtable Scott beat Stubberfield 4—2, and Hancock 4—3, but went down to the more combative Turner on the odd point. Reid, the best Army sabreur in the team, contributed another two wins, his only loss being 4—2 to Hancock, while the latter proved the R.A.F.'s most successful man.

A magnificent battle resulted in another Army win, as in the foil, decided on the odd point of the final fight, and the totals were 15—12 in the airmen's favour, with the bayonet to go.

Last year the R.A.F. lost to the Army through bayonet weakness, but their lead on this occasion meant that they had only to win four of the nine fights to secure the match. This was a sufficiently severe task, but they tackled it gallantly.

The Army opened with a 3—1 win by Gelder over Digby, but Eyles replied with a similar victory over Laxton. Turner registered the R.A.F.'s second win when he made the odd point against Williams, but Gelder equalised by beating Eyles 3—1.

Laxton brought the Army totals to 15—17 with four to go by his last point victory over Turner, but Digby's odd hit against Williams made the R.A.F. 18—15 and safe to draw, at least.

Followed a terrific battle between Turner and the unbeaten Gelder, which ended 3—1 in the airman's favour, and secured the day for his side at 19—15.

Laxton reduced the Army's deficit by a 3—1 score over Digby, but, equally determined, Eyles, the champion, wound up the R.A.F.'s day of glory with a similar score against Williams, to close with the totals at 20—16.

TEAMS AND SCORES

Foil.—Army: S.M.I. J. T. Reid, 3 wins, 0 defeats, 9 hits; Q.M.S.I. H. Parsons, 2—1—7; S.M.I. G. A. F. Wyatt, 0—3—12. Total, 5 wins. *Royal Air Force:* Sqd. Ldr. F. G. Sherriff, 2—1—7; Flt. Sgt. Digby, 1—2—9; Sgt. W. R. Hancock, 1—2—10. Total, 4 wins.

Épée.—Royal Air Force: Flt. Sgt. F. J. Stubberfield, 3—0; F/O. E. H. Bellairs and Sgt. Jarrold, each 2—1. Total, 7 wins. *Army:* S.M.I. A.J. Keen and Q.M.S.I. Harris, each 1—2; Lt. East, 0—3. Total, 2 wins.

Sabre.—Army: Lt. C. R. Scott and S.M.I. J. T. Reid, each 2—1—9; Lt. R. D. S. Anderson, 1—2—11. Total, 5 wins. *Royal Air Force:* Sgt. W. R. Hancock, 2—1—8; Flt. Sgt. F. J. Stubberfield, 1—2—9; Cpl. W. H. Turner, 1—2—11. Total, 4 wins.

Bayonet.—Royal Air Force: Sgt. R. F. Eyles, 2—1—5; Cpl. W. H. Turner, 2—1—6; Flt. Sgt. Digby, 1—2—8. Total, 5 wins. *Army:* C.M.S.I. Gelder, 2—1—5; C.M.S.I. Laxton, 2—1—6; Bugler Williams, 0—3—9. Total, 4 wins.

M. P. S.

THE ROYAL AIR FORCE MEMORIAL FUND

THE first meeting of the governing body of the above Fund was held at Iddesleigh House on March 23. Sir Charles McLeod, Bart., Chairman and Honorary Treasurer, was in the Chair and was supported by Dame Helen Gwynne-Vaughan, G.B.E., Deputy Chairman, and there was a large attendance of members.

After the usual financial matters had been disposed of the Committee proceeded to give approval and sanction to the publication of the Annual Report for 1931, the accounts of the Fund having been audited and passed by the Auditors, Messrs. Barton, Mayhew & Co., Alderman's House, Bishopsgate, E.C.2. The accounts showed that the Fund had distributed during the year 1931 under report the very large sum of £12,994, this being entirely spent in relief of distress amongst officers and airmen and their families.

The Committee approved of the publication of the Report, which will be issued in a few days' time.

The meeting were informed that the School, supported and administered by the Fund at Vanbrugh Castle, Blackheath, opened for the Spring term on January 12 last with a full complement of forty boys.

The Grants Committee since the last meeting of the Executive Committee on December 9, 1931, had dealt at their fortnightly meetings with 105 cases (98 war cases and 7 post-war cases) and that, in addition, the Secretary had dealt with 237 cases (170 war cases and 67 post-war cases) in all of which grants had been made.

The Committee, after discussion, approved of the stone work of the R.A.F. Memorial on the Victoria Embankment being cleaned during the Spring.

The last item on the agenda was a very important matter, which concerned the organisation of the Fund in the future, and in this respect a sub-committee had been formed and held a meeting in January last, and the proceedings of that meeting were put before this meeting for consideration, and after discussion, it was decided that the body now known as "the Executive Committee" be in future known as "the Council," and various rules were adopted as to the constitution of the Council, and the period of membership therein and three committees under the Council were adopted as follows:—Vanbrugh Castle Committee for the administration of that School; a Grants Committee for the administration of relief; a Finance Committee to decide all matters of finance, subject to confirmation of the Council at subsequent quarterly meetings.

The present members of the Executive Committee were re-elected to the Council, and the same rule was followed in respect to the existing members of the Vanbrugh Castle School Sub-Committee and the Grants Sub-Committee.

Copies of the new constitution have already been furnished to members of the Executive Committee, and in the course of a short time will be forwarded to H.R.H. the Duke of York, who is President of the Fund and to all Vice-Presidents, Trustees and to others concerned.

The following are extracts from the Twelfth Report, covering the year January 1 to December 31, 1931:—

"For the past eleven years by far the largest annual contribution to the Fund has been the donation from the Air Council, which represents part of the proceeds of the Royal Air Force Display at Hendon. In 1931 £9,362 13s. 11d. was received from this source. A further sum of £1,600 was received from this source. A further sum of £1,600 was provided by the Air Council, being the Royal Air Force share of the profits of the Royal Tournament at Olympia.

"The Executive Committee have received from the Air Officer Commanding Royal Air Force, Middle East, a donation of £512 16s. 5d., the product of an Air Display held in Egypt on February 20, 1931. From the Air Officer Commanding in India a donation of £262 6s., part proceeds of a Display at New Delhi, was also received.

"With the consent of the Chaplain-in-Chief, and with the approval of Air Officers Commanding, collections at Church Parade Services of all denominations were again made throughout the Royal Air Force at Armistice time, and, with other Armistice donations, realised a sum of £156 16s. 4d. The Executive Committee again wish to thank the Rev. J. H. P. Still, M.A., Chaplain, R.A.F., Manston, Kent, for kindly collecting and forwarding these donations.

"The total amount expended during 1931 on relief and assistance of all kinds was £12,993 13s. 6d.

"A few cases selected irrespective of the amounts concerned, are epitomised below:—

"G. 2730. Mother of a flying officer who died as the result of a flying accident. This widow's total income is £95 a year, and she has received help in 1925, 1929, 1930, and in the year under report was granted £7 to clear arrears of rent.

"G. 5232. An ex-Corporal (invalided). Has been helped by the Fund on several occasions since August, 1929, and in the year under report received a grant of £25 to set up a small business.

"G. 6472. An ex-N.C.O., R.F.C. and R.A.F., 1916-1919. Granted £13 13s., towards cost of three months' treatment in a sanatorium. Suffering from neurasthenia.

"G. 6319. An ex-airman. Was granted £10 towards travelling expenses of his son, ordered to Switzerland in the hope of curing a long-standing attack of asthma.

"G. 5783. An ex-Flight Sergeant (a post-war enlistment). In this case the Grants Sub-Committee made a grant in August, 1931, of £50 towards cost of fees at King's College, London, for training for ordination, a grant of a similar amount having also been made in July, 1930.

"G. 4476. An ex-officer, R.N.A.S. (invalided for T.B.). Married. No pension. Granted a maintenance allowance from time to time since August, 1928."

The "Comrades of the Royal Air Forces" Association

A LADIES' dance band from the West End, known as "The Bandits," has been secured by the Hounslow, Heston and District Branch of the above Association for their First Annual Carnival Dance, to be held at the Osterley Hotel, Great West Road, on Friday, May 6, 1932. This band is composed entirely of society ladies, who have just completed a tour of the Continent. There are numerous Spot and other prizes offered, including tickets for flights from Hanworth and Heston, balloon prizes and novelties. The Branch is steadily increasing its membership, and forthcoming fixtures are being arranged.

THE ROYAL AIR FORCE

London Gazette, April 19, 1932.

General Duties Branch

H. D. Parsons-Smith is granted a short-service commn. as Pilot Officer on probation, with effect from and with seny. of March 28. The follg. are granted permanent commns. as Pilot Officers on probation with effect from and with seny. of April 8 :—363901 Sergeant D. I. Coote, 364944 Sergeant A. T. Monks, 363910 Sergeant R. G. Bowditch.

Lt.-Cdr. G. F. Renwick, R.N., is re-attached to R.A.F. as Flying Officer with effect from April 4, and with seny. of Jan. 12, 1925; Lt.-Cdr. R. R. Graham, R.N., is re-attached to R.A.F. as Flight Lieut. with effect from April 8, and with seny. of July 1, 1928. The follg. Pilot Officers are promoted to rank of Flying Officer :—A. C. Drew (Feb. 28) ; A. H. Garland, A. H. Hole, D. H. Marsack, F. G. Mason, M. A. Payn (March 12) ; G. R. Canavan (April 10).

Wing Commander C. H. Elliott-Smith, A.F.C., is placed on half-pay list, Scale A, from April 9 to April 10, both dates inclusive (substituted for *Gazette* April 5) ; Flight Lieut. H. E. Forrow is seconded for duty under Iraq Government (April 1) ; Flight Lieut. A. S. Cheshire, M.B.E., is placed on retired list (April 15) ; Flying Officer Lord M. A. Douglas-Hamilton resigns his permanent commn. (April 20).

Medical Branch

Group Captain H. W. Scott, M.B., B.Ch., M.R.C.S., L.R.C.P., is placed on retired list on account of ill-health (April 15).

Chaplains Branch

The Rev. H. F. Daniels, Chaplain to the Forces, 4th Class (T.A.), is granted a short service commn. as Chaplain (Wesleyan), with relative rank of Sqdn.-Ldr. (April 12).

Memorandum

The permission granted to Lt. J. R. Preece to retain his rank is withdrawn on his conviction by the Civil Power (Feb. 26).

ROYAL AIR FORCE RESERVE
RESERVE OF AIR FORCE OFFICERS

General Duties Branch

J. T. Percy is granted a commn. in Class AA (i) as Pilot Officer on probation (March 12) ; Flight Lieut. S. J. Stocks is transferred from Class A to Class C (Nov. 5, 1931) (substituted for *Gazette* March 29) ; Flying Officer W. R. Bailey is transferred from Class AA (i) to Class C (Oct. 4, 1931) ; Flying Officer G. B. Rahr is transferred from Class AA (ii) to Class C (April 9) ; Flying Officer R. H. Bibby relinquishes his commn. on completion of service (April 15) ; the notification in *Gazette* of Feb. 16 concerning Flying Officer G. E. Klein is cancelled.

AUXILIARY AIR FORCE

General Duties Branch

No. 605 (County of Warwick) (Bomber) Squadron.—Pilot Officer R. P. Gibb resigns his commn. (Aug. 7, 1930).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

Group Captain : W. C. Hicks, A.F.C., to Station H.Q., Upper Heyford, 12.4.32, to Command vice Group Capt. G. I. Carmichael, D.S.O., A.F.C.

Squadron Leader : W. Underhill, D.S.C., to Air Ministry (D.T.D.), 14.4.32, for Navigational Instrument duties vice Commander F. N. Miles, O.B.E.,R.N.

Flight Lieutenants : C. A. B. B. Wilcock, to R.A.F. Record Office, Ruislip, 9.4.32. J. F. Clark, to Central Flying Sch., Wittering, 1.4.32. H. F. Bradley, to Station H.Q., Boscombe Down, 9.4.32. A. D. H. Foster, to Station H.Q., Kenley, 12.4.32. J. H. McN. Campbell, to No. 210 (FB) Sqdn., Pembroke Dock, 14.4.32.

Flying Officers : G. F. Whistondale, to R.A.F. Base, Gosport, 6.4.32. H. A. G. Comerford, to No. 31 (AC) Sqdn., Quetta, India 18.3.32. N. E. Pickford, to No. 60 (B) Sqdn., Kohat, India, 1.3.32. A. D. Jaffé, to R.A.F. Base, Gosport, 12.4.32. G. P. Charles, to Elec. & Wireless Sch., Cranwell, 13.4.32. A. H. Button, to R.A.F. Base, Gosport, 11.4.32. H. I. Dabinett, to Station H.Q., Hal Far, Malta, 15.4.32.

Pilot Officers : A. T. Monks, to No. 18 (B)Sqdn., Upper Heyford, 8.4.32, on appointment to a Permanent Commn. (on probation). R. G. Bowditch, to No. 207 (B) Sqdn., Bircham Newton, 8.4.32, on appointment to a permanent commn. (on probation). D. I. Coote to No. 111 (F) Sqdn., Hornchurch, 8.4.32, on appointment to a permanent commn. (on probation). J. Ramsden, to No. 55 (B) Sqdn., Hinaidi, Iraq, 24.3.32.

Stores Branch

Squadron Leaders : A. W. Smith, to H.Q., Air Defence of Gt. Britain, Uxbridge, 11.4.32, for Stores Staff duties vice Sq. Ldr. A. E. Sutton-Jones. A. E. Sutton-Jones to H.Q., Fighting Area, Uxbridge, 15.3.32, for Stores Staff duties, vice Sq. Ldr. F. Anderson. F. R. Wilkins, to Air Ministry (D. of E.) 11.4.32, for Stores Staff duties, vice Sq. Ldr. A. W. Smith.

Medical Branch

Squadron Leader E. N. H. Gray, to Station H.Q., Boscombe Down, 11.4.32, for duty as Med. Officer.

Flight Lieutenant (Hon. Sq. Ldr.) : C. A. E. I. Brownlee, to H.Q., Coastal Area, Lee-on-Solent, 8.4.32.

Flight Lieutenant : A. Harvey, to Aircraft Depot, Karachi, India, 15.3.32.

Chaplains Branch

The Rev. H. F. Daniels is posted to No. 1 School of Tech. Training (Apprentices), Halton, on 12.4.32, for duty as Chaplain (Wesleyan) on appointment to a Short Service Commn.

NAVAL APPOINTMENTS

The following appointments have been made by the Admiralty :—

Lieuts. (F/O., R.A.F.).—A. J. Tillard, to *Courageous* (Feb. 22) ; and T. P. Coode, to *Courageous* (Feb. 22) ; to *Victory*, for R.A.F. Base, Gosport (April 21) ; and to *Glorious* for 448 Flight.

Royal Air Force

Pilot Offr.—N. E. Morrison, to *Courageous*, for 450 (F.S.R.) Flight (April 15).

THE R.A.F. AFLOAT : As recorded in " Flight " the other week, the British Power Boat Co., of Hythe, Southampton, recently received from the Air Ministry an order for 18 motor-boat tenders for R.A.F. seaplane stations at home and overseas. These boats are now completed, and our picture shows some of them carrying out manœuvres recently in Southampton Water. Fitted with two 100-h.p. engines, they have a speed of 30 m.p.h. They were designed by Mr. Hubert Scott-Paine, who is well known to our readers in his connections with the Supermarine Aviation Works and Imperial Airways.

AIRCRAFT COMPANIES' STOCKS AND SHARES

On balance for the month, industrial shares have moved against holders, but there are few heavy declines, and at the time of writing a rather better tendency has developed partly in sympathy with the steadier showing of Wall Street markets, but mainly on support following the Government's tariff proposals. The further reduction in the Bank rate naturally benefited British Government stocks, and also to a lesser extent the debentures and preference shares of industrial companies, including those of aircraft and allied companies. At the time of writing Fairey Aviation are quoted at 13s. 9d., as compared with 15s. 1½d. a month ago, but there has been little selling reported and the decline merely represents the general tendency shown during the month by active industrial shares. De Havilland have not attracted much attention judged by markings of business, but dealings have been recorded recently at 15s. 3d. and 15s. 7½d., and the quotation is unchanged on the month at 16s. 3d. During the month Handley Page participating preference lost 2s. to 8s. 6d. The report is due this month, and the market is apparently not looking for an increase in the dividend on these shares. Rolls-Royce at 34s. are 1s. lower on balance, but this is explained by the fact that the quotation has gone "ex" the dividend. The market was favourably impressed by the statements at the meeting. Ford Motors were offered quite freely on the absence of a dividend, and are now quoted at 21s. 9d. In the past they have tended to move closely with Wall Street markets, and may therefore respond if the latter show real improvement before long. Imperial Airways have been a bright spot again, with a rise from 14s. 6d. to 15s. 6d. As was mentioned a month ago, the support for the shares is due to the hope that the company is in a better position than last year to compete for traffic owing to the lower external value of the pound sterling. "Shell" have been weak, but were inclined to rally on the statement on the position made by the chairman last week. Market estimates of the dividend range from 5 to 7½ per cent., tax free, as against the previous year's 17½ per cent., tax free. Dunlop Rubber are 9s., compared with 11s. 3d. a month ago, and the "C" preference show a rather larger decline. The market is prepared for the further postponement of preference dividends, as it believes the directors will decide to conserve resources. D. Napier are 1s. 1½d. down on the month, and remain under the influence of the frank statement of the position at the annual meeting. Nevertheless, they appear to be held fairly tightly on the good financial position. The 7½ per cent. preference have gained 1s. 3d. to 20s. National Flying Services are a shade better on the month at 4½d.

Name.	Class.	Nominal Amount of Share.	Last Annual Dividend. %	Current Week's Quotation.
Anglo-American Oil	Deb.	Stk.	5½	100½
Armstrong Siddeley Develop.	Cum. Pref.	£1	6½	13/9
Birmingham Aluminium Castg.	Ord.	£1	5	19/6
Booth (James), 1915	Ord.	£1	15	42/9
Do. do.	Cum. Pref.	£1	7	23/6
British Aluminium	Ord.	£1	5	23/–
Do. do.	Cum. Pref.	£1	6	20/7½
British Celanese	Ord.	10/–	Nil	7/3
British Oxygen	Ord.	£1	3	11/3
Do. do.	Cum. Pref.	£1	6½	20/7½
British Piston Ring	Ord.	£1	10	25/–
British Thomson-Houston ..	Cum. Pref.	£1	7	24/–
Brown Brothers	Ord.	£1	10	26/3
Do. do.	Cum. Pref.	£1	7½	23/9
Dick (W. B.)	Cum. Pref.	£10	5	115/–
De Havilland Aircraft ..	Ord.	£1	5	16/3
Dunlop Rubber..	Ord.	c	6	9/–
Do. do.	"C" Cum. Pref.	16/–	10	8/9
En-Tout-Cas (Syston)	Def. Ord.	1/–	Nil	1/–
Do. do.	Ptg. Pfd. Ord.	5/–	8	2/6xd
Fairey Aviation	Ord.	10/–	10*	13/9
Do. do.	1st Mt. Deb.	Stk.	8	104
Firth (T.) & John Brown ..	Cum. Pref.	£1	6D	7/6
Do. do. ..	Cum. Pref.	£1	5*D	6/–
Ford Motor (England).. ..	Ord.	£1	Nil	21/9
Fox (Samuel)	Mt. Ptual. Deb.	Stk.	5	72½
Goodyear Tyre & Rubber ..	Deb.	Stk.	6½	99
Handley Page	Ptg. Pref.	8/–	12½	8/6
Hoffmann Manufacturing ..	Ord.	£1	Nil	15/1½
Do. do. ..	Cum. Pref.	£1	7½	15/–
Imperial Airways	Ord.	£1	3	15/6
Kayser, Ellison	Ord.	£5	Nil	55/–
Do. do.	Cum. Pref.	£5	6	75/–
Lucas (Joseph)	Ord.	£1	20	58/9xd
Napier (D.), & Son	Ord.	5/–	Nil	3/6
Do. do.	Cum. Pref.	£1	7½	20/–
Do. do.	Pref.	£1	8	16/3
National Flying Services ..	Ord.	2/–	Nil	–/4½
Petters	Ord.	£1	6	17/6
Do.	Cum. Pref.	£1	7½	17/6
Roe (A.V.) (Cont. by Armstrong-Siddeley Devel., *q.v.*)	Ord.	£1	—	—
Rolls-Royce	Ord.	£1	10	34/–xd
Smith (S.) & Sons (M.A.) ..	Def. Ord.	1/–	Nil	1/6
Do. do. ..	Ptg. Pfd. Ord.	£1	7	12/6
Do. do. ..	Cum. Pref.	£1	7½	15/–
Serck Radiators	Ord.	£1	15	30/–
"Shell" Transport & Trading	Ord.	£1	17½*	33/9
Do. do.	Cum. Pref.	£10	5	£9¾
Triplex Safety Glass	Ord.	£1	10	31/3
Vickers	Ord.	6/8	5	7/3xd
Do.	Cum. Pref.	£1	5*	17/–
Vickers Aviation (Cont. by Vickers, *q.v.*)..	—	—	—	—
Westland Aircraft (Branch of Petters, *q.v.*)	—	—	—	—

* Dividend paid tax free. c £1 unit of stock. D Last xd. on March 19, 1931.

"Facilis Descensus"

In our issue for January 15 last we published a full-page illustration bearing the above caption, showing Lt. J. Reece making a parachute descent at Melbourne airport. At the time we omitted to mention that the photograph was taken by *The Argus* of Melbourne—and now hasten to amend our omission with apologies.

PUBLICATIONS RECEIVED

Service in Life and Work. Spring 1932. Vol. 1. No. 1. Rotary International Association, Tavistock House (South), Tavistock Square, London, W.C.1. Price 6d.

The Aircraft Year Book for 1932. Compiled by the Aeronautical Chamber of Commerce of America, Inc. New York: D. Van Nostrand Co., Inc. Price $6.00.

Revue Générale de l'Aéronautique. Vol. 13. *Aviation in* 1931. E. Chiron. Librairie Aéronautique, 40, Rue de Seine, Paris. Price 30 fr.

The Skycraft Book. By Laura B. Harney. New York: D. C. Heath and Co. Price $1.08.

A Rabbit in the Air. By David Garnett. London: Chatto and Windus. Price 5s. net.

La Guerre de l'Air. By General Douhet. "Les Ailes," 65, Faubourg Poissonniere, Paris. Price 15 fr.

Technical Report of the Aeronautical Research Committee, 1930–31. Vol. I. *Aerodynamics.* Vol. II. *Stability and Control. Engines, etc.* London: H.M. Stationery Office, W.C.2. Price: Vol. I, £1 5s. net. Vol. II, £1 12*s.* 6*d.* net.

Brico Piston Ring Catalogue and Directory. The British Piston Ring Co., Ltd., Holbrook Lane, Coventry.

Sailplanes: Their Design, Construction and Pilotage. By C. H. Latimer Needham. London: Chapman and Hall, Ltd. Price 15*s.* net.

AERONAUTICAL PATENT SPECIFICATIONS

(*Abbreviations*: Cyl. = cylinder; i.c. = internal combustion; m. = motors. The numbers in brackets are those under which the Specification will be printed and abridged, etc.)

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Published April 28, 1932

33,565. Dornier-Metallbauten Ges. and C. Dornier. Aircraft wings. (370,056.)

39,132. A. Richinson. Airships. (370,004.)

APPLIED FOR IN 1931

Published April 28, 1932

4,405. Sir W. G. Armstrong Whitworth Aircraft, Ltd., H. N. Wylie and P. G. Crabbe. Tool for crushing or cutting metal. (370,106.)

5,492. E. A. Link, Jun. Training device for aviators. (370,128.)

5,508. Sir W. G. Armstrong Whitworth Aircraft, Ltd., and H. R. Watson. Aircraft. (370,130.).

13,096. Eclipse Aviation Corporation. Spark plugs. (370,215.)

25,128. Fiat Soc. Anon. Framework girders more particularly for aeroplane fuselages. (370,322.)

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